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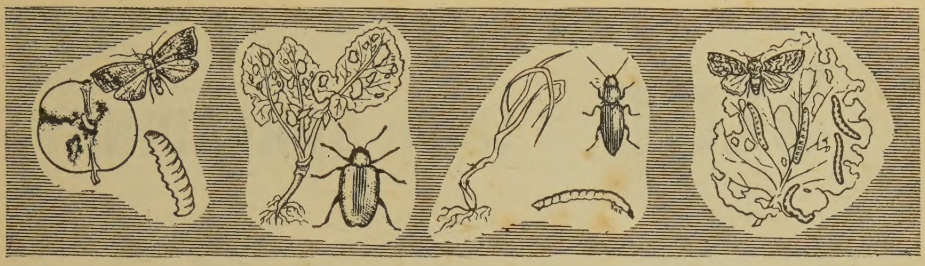

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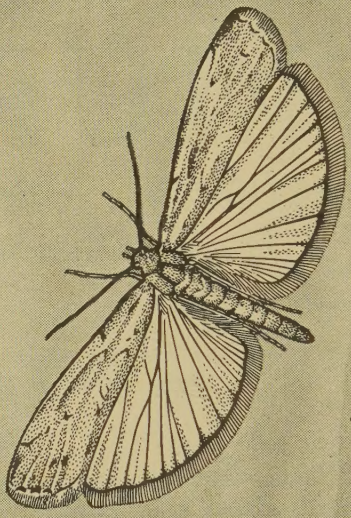

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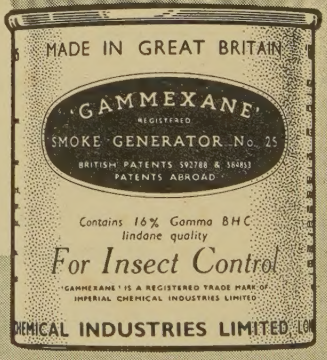

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Olalquiaga Fauré (G.). **Insect Pest Problems in Chile.**—*FAO Plant Prot. Bull.* **3** no. 5 pp. 65–70, 1 ref. Rome, 1955.

The author reviews the insects and mites that are of importance in Chile as pests of plants or stored products and estimates that the crop losses caused by them amount to some 15–20 per cent. of the national production. Some of the information has already been noticed [*cf. R.A.E.*, A **36** 108; **42** 30]. Wheat is attacked by the armyworms, *Protoleucania albilinea* (Hb.), *Feltia subterranea* (F.) (*annexa* (Treitschke)), *Pseudaletia* (*Cirphis*) *unipuncta* (Haw.) and *P. impuncta* (Gn.), the last of which also attacks barley, and by larvae of the Lamellicorns, *Athlia rustica* Erichs., *Phytolaema herrmanni* Germain, *Hylamorpha elegans* (Burm.) and *H. cylindrica* Arr., which can be controlled in fields to be sown with wheat in autumn by applications of aldrin and BHC in late spring, when the females enter the soil to oviposit, and the adults of which feed on forest trees, particularly *Nothofagus* sp. [*cf.* **41** 420]. Other cereal pests include *Toxoptera graminum* (Rond.) and *Tipula apterogyne* Philippi, on oats and wheat, and *Heliothis armigera* (Hb.), *Laphygma* (*Prodenia*) *eridania* (Cram.) and *Elasmopalpus lignosellus* (Zell.) on maize.

Pests of forage crops include larvae of the genera *Leptotes*, *Hemiargus* and *Hylephila*, which together destroy four of the six cuttings of lucerne. A Tachinid parasite, *Incamyia chilensis* Aldr., is being propagated for their control, and BHC and aldrin are also applied. Clover is now less widely grown than formerly, owing partly to the damage caused to the seed crops by *Bruchus* (*Bruchidius*) sp. *Maculella* (*Dalaca*) *noctuides* (Pfitzner) attacks clover, orchard grass (*Dactylis glomerata*) and rye grass (*Lolium* sp.) in pastures. BHC is ineffective against this Hepialid, but DDT, methoxy-DDT (methoxychlor) and aldrin give control and the sowing of fescue (*Festuca*) and oat grass (*Arrhenatherum elatius*), which are not seriously damaged by it, is recommended. Potatoes are attacked by *Gnorimoschema operculella* (Zell.), which is parasitised by *Arrenoclavus koehleri* (Blanch.) [*cf.* **41** 188], and are also injured by *Epicauta pilmus* (Molina), which can easily be controlled by hand collection or treatment with DDT. Tomatos are attacked by *Heliothis armigera*, *G. operculella* and especially *Rhagoletis ochraspis* (Wied.), which causes considerable loss of the export crop. *Thrips tabaci* Lind. is important on onion, watermelon and other plants. Cucurbits are severely damaged by *Diaphania nitidalis* (Stoll) in the north, and muskmelons and watermelons are attacked by *Hylemyia* sp. in central districts. Near Valparaiso, artichokes (*Cynara scolymus*) are severely injured by *Lygus fraudulentus* (Stål) [*cf.* **35** 355] and *Aphis gossypii* Glov. Sugar beet is affected by two virus diseases, yellow wilt and curly-top, and the Jassid, *Atanus exitiosus* Beamer, a possible vector [*cf.* **35** 426], is widely distributed in Chile.

Orchard pests include *Quadraspidiotus perniciosus* (Comst.) on most fruit trees; *Vasates cornutus* (Banks) on peach; *Lophotus phaleratus* (Erichs.), *Taeniothrips frici* (Uzel), *Frankliniella cestrum* Moult. and *Haplothrips* spp. on plum; *Cydia* (*Carpocapsa*) *pomonella* (L.) on apple and walnut; *Graphidothrips stuardoi* Moult. on fig [*cf.* **35** 354]; *Heliothrips haemorrhoidalis* (Bch.) on avocado; and *Pseudococcus* and *Icerya purchasi* Mask., which are controlled by natural enemies, and *Lepidosaphes beckii* (Newm.) on *Citrus*. Olive is infested by *Saissetia oleae* (Bern.), against which parasites are effective in Azapa [*cf.* **35** 21], *S. coffeae* (Wlk.) (*hemisphaerica* (Targ.)) and *Hylesinus oleiperda* (F.), and grape vines are attacked by *Margarodes vitium* Giard, *Eulecanium* (*Lecanium*) *persicae* (F.) and *Pantomorus xanthographus* (Germ.).

Of the numerous pests of forest trees and timber that are reviewed, most attention has been given to the control of *Chermes boerneri* (Annand),

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Catocephala amphinome (F.) and *Macromphalia dedecora* (Feisth.) [*cf.* **35** 7], all of which infest pine. *Gladiolus* is attacked by *Taeniothrips simplex* (Morison), and rose by *Macrosiphum rosae* (L.). The principal pest of stored grain is *Calandra* (*Sitophilus*) *granaria* (L.); *Sitotroga cerealella* (Ol.) and *Rhizopertha dominica* (F.) do not occur in Chile, but the former is the chief pest of maize on Easter Island, and imports of grain from there are consequently prohibited. Two species of *Chrysomela* (*Chrysolina*) have been introduced for the control of the weed, *Hypericum perforatum*, which is beginning to spread in Chile.

Arriaga (H. O.). **Resistencia a la toxemia de** *Schizaphis graminum* **(Rond.) en cereales finos.** [Resistance to Toxaemia caused by *Toxoptera graminum* in small Grains.]—*Rev. Fac. Agron. Eva Perón* **30** no. 1 pp. 65–101, 10 figs., 5 graphs, 27 refs. Eva Perón, 1954. (With a Summary in English.)

The author reviews the literature on the factors responsible for resistance of plants to insects [*cf. R.A.E.*, A **30** 177, 179; **40** 370] and on resistance in cereals to *Toxoptera* (*Schizaphis*) *graminum* (Rond.) [*cf.* **33** 70; **34** 375; **36** 49; **38** 33]. As a result of studies begun in Argentina in 1944, several lines of rye resistant to the toxic effects of the saliva of this Aphid were developed and consistently maintained their resistance, and an account is given of further studies made in 1950–53 with cultivated varieties of wheat, oats and barley for the same purpose. As none of these showed resistance, the studies were extended to include wild or little-cultivated species of *Triticum*, *Avena*, *Hordeum* and *Aegilops*. Some resistance was shown by all four species of *Aegilops* investigated, by two of *Avena* and by one of *Hordeum*. It is considered unlikely that a resistant pure line of wheat can be developed, but it may be possible to introduce the resistant factor by intergeneric crossing with the lines of rye already developed or with the resistant species of *Aegilops*. It may be possible to incorporate the resistant factor observed in *Hordeum* (which is known to be present in species and varieties of *Hordeum* studied elsewhere) into the varieties of barley commonly cultivated, through interspecific crosses. Further studies are required in the case of oats, which appears to be highly susceptible.

Moutia (L. A.). **Considérations préliminaires sur le complexe biologique de l'araignée rouge à Maurice.**—*Rev. agric. Maurice* **32** no. 2 pp. 76–82, 3 refs. Port Louis, 1953.

Tomato, egg-plant (*Solanum melongena*) and potato in Mauritius have of recent years been severely attacked by an unidentified species of *Tetranychus* other than *T. telarius* (L.). Observations on tomato and egg-plant showed that development was continuous throughout the year and was favoured by dry, hot weather. Infestation was slight on the plateaux in April–August, but severe at the lower levels, and the mite was usually abundant throughout the island in August–October. Numbers in November–March varied inversely with rainfall and dropped sharply with the onset of the rainy season. The apparent increase in infestation is thought to be due to increased cultivation of tomato and egg-plant at periods favourable for the development of the mite. Its wild food-plants (of which *Solanum* spp. are among the most important) and infested plant débris left near fields serve as foci of infestation, and when egg-plants were grown with tomatos, the former, which are attacked throughout the 1–2 years of their

development, provided a constant source of infestation for successive tomato crops, so that a change of cultural practice is desirable.

The mite was attacked by a succession of predators, but none afforded effective control. The first to appear in new colonies was an unidentified Cecidomyiid that attacked almost all stages. It was followed in some areas by *Stethorus vinsoni* Kapur, a Coccinellid that was abundant in coastal regions in August–October and sometimes reduced infestation to a minimum, but also attacked the Cecidomyiid larvae. This was succeeded, especially on the plateaux, by *Oligota pallidicornis* Cam., *Exochomus flavipes* (Thnb.) and a species of *Scolothrips*, probably *S. indicus* Priesn., which was commonest on beans. A predacious mite of the genus *Amblyseius* was occasionally observed on egg-plant on the coast. Two Coccinellids, *Stethorus jejunus* Csy. and *S. picipes* Csy., were introduced into Mauritius from South Africa in 1950 and from Canada in 1952, respectively, for the control of the mite, and laboratory tests showed that the second of these attacked the mite readily and completed development on it. Colonies were liberated in various localities. The application of sulphur sprays has not given good control, since they destroy the predators, particularly the Cecidomyiid larvae, and too few applications are made to prevent the consequent increase in the mite.

Chatterjee (P. N.). **Protection of Plywood in Storage in Godowns against *Lyctus* Beetles by Treatment with Dichloro-diphenyl-trichloroethane (D.D.T.) and Benzene Hexachloride (B.H.C.).**—*Indian For.* **79** no. 5 pp. 304–306, 2 refs. Dehra Dun, 1953; also as *Indian For. Leafl.* (Ent.) no. 135, [1+] 3 pp., 2 refs. Dehra Dun, 1953.

In experiments at a factory at Dandeli, in Bombay State, spraying the edges of tightly bound bundles of plywood panels with 2–4 per cent. DDT or 0·2–0·4 per cent. BHC in kerosene afforded complete protection against attack by *Lyctus* and *Heterobostrychus aequalis* (Waterh.) for ten months. Untreated bundles were moderately attacked by both pests.

Vodjdani (S.). **Contribution à l'étude des punaises des céréales et en particulier d'*Eurygaster integriceps* Put. (Hemiptera, Pentatomidae, Scutellerinae).**—*Ann. Épiphyt.* **5** no. 2 pp. 105–160, 15 figs., 53 refs. Paris, 1954.

The author describes the principal characters of the genus *Eurygaster* and gives a key to the adults of the 14 known species of it, a list of the latter showing their synonymy, distribution and economic importance, descriptions of all stages of *E. integriceps* Put. and an account based largely on one already noticed [*R.A.E.*, A **41** 28] of observations on its bionomics, parasites and control on the plain of Varamin, near Teheran, where it causes severe damage to wheat and other cereals.

Van den Brande (J.). **Présence de *Ceratitis capitata* Wied. en Belgique.**—*Bull. Ann. Soc. ent. Belg.* **89** no. 3–4 p. 66. Brussels, 1953.

Ceratitis capitata (Wied.) was found for the first time on fruit grown in Belgium towards the end of 1952, when it occurred on peach in a garden near Ghent. It was not known whether it would become acclimatised [*cf. R.A.E.*, A **28** 55].

Crooke (M.). **The Pine Looper Moth.**—*Quart. J. For.* **48** no. 1 pp. 36–38, 2 pls. London, 1954.

An outbreak of *Bupalus piniarius* (L.), which is widespread but has not so far been of economic importance in Britain, occurred on Scots pine [*Pinus sylvestris*] in the Cannock Chase forest near Birmingham in 1953, when trees covering 120 acres were defoliated. All stages of the moth are briefly described, and its bionomics are reviewed.

Węgorek (W.). **Preparaty heksachlorocykloheksanowe (HCH) w walce ze szkodnikami glebowymi.** [Preparations of BHC in the Control of Soil Pests.]—*Roczn. Nauk roln.* **69** (A) pt. 4 pp. 613–624, 9 refs. Warsaw, 1954. (With Summaries in Russian and English.)

The author briefly reviews the properties of BHC and the forms in which it is used for the control of soil pests, and gives an account of experiments carried out in clearings in a pine forest in Poland in 1949–50 with two proprietary preparations, of which one contained 1·6 per cent. γ BHC in kaolin and the other 0·65 per cent. γ BHC in dolomite. Both were used at rates of 0·54, 0·9, 1·35 and 1·8 lb. γ BHC per acre. The first was applied early in April 1949 as an aqueous suspension poured into evenly distributed slits cut in turf to a depth of 8 ins. by means of a spade, and the second was applied as a dust at the beginning of November to arable soil into which it was hoed and raked. Counts made before and a year after treatment showed that the numbers of Lamellicorn larvae and wireworms in soil samples were reduced by all treatments, the reduction varying almost directly with the rate of application and being 90·5 and 100 per cent. for the dust and liquid at the highest rate, respectively, as compared with an increase of 47·4 and a decrease of 10·2 per cent. for no treatment. In a further test with the dust in the spring of 1950, complete mortality was obtained in four months by applying it at the highest rate but in three doses, the first before ploughing and the others before subsequent cultivations. Of the wireworms present, *Athous subfuscus* (Müll.), *Melanotus rufipes* (Hbst.) and *Dolopius marginatus* (L.) were killed by γ BHC at 0·9 lb. per acre and *Corymbites sjaelandicus* (Müll.) (*tessellatus*, auct.) and *Agrypnus* (*Brachylacon*) *murinus* (L.) by 1·35 lb., and of the Lamellicorns, *Anomala* (*Phyllopertha*) *horticola* (L.) was killed by 0·9 lb., *Anomala dubia aenea* (Deg.), *Serica brunnea* (L.) and first-year larvae of *Amphimallon* (*Amphimallus*) *solstitiale* (L.) by 1·35 lb., and second-year larvae of *A. solstitiale* and third-year larvae of *Melolontha* sp. by 1·8 lb.

Field experiments with application of BHC limited to the area immediately surrounding the plants were begun in the spring of 1949 in a clearing heavily infested by larvae of *Melolontha*. Pine seedlings were planted in holes sprayed with a suspension of the first preparation at the rate of 0·003 gm. γ BHC per plant or dusted with the second at the rate of 0·007 gm. γ BHC per plant, or in untreated holes after the roots had been soaked in a suspension of the first containing 0·005 gm. γ BHC per root. The results were estimated 12 and 18 months later, when it was found that the best protection was afforded by soaking the roots, which reduced the number of larvae per sq. metre to 0·2 as compared with an initial 7·2 and resulted in only 5 and 13·5 per cent. seedlings killed after 12 and 18 months, respectively, as compared with 90 and 95 per cent. in the controls. This treatment also stimulated growth. The other treatments gave less good results, spraying the holes being much inferior to dusting.

Lityński (M.) & Wiłkojć (A.). **Zastosowanie podczerwieni do zwalczania strąkowców (Bruchidae).** [The Application of infra-red Rays for the Control of Bruchids.]—*Roczn. Nauk roln.* **69** (A) pt. 4 pp. 625–639, 15 refs. Warsaw, 1954. (With Summaries in Russian and English.)

The authors summarise the bionomics of *Bruchus pisorum* (L.), which is a major pest of peas in Poland, the eggs being laid in the maturing pods and the Bruchids completing their development in the stored seeds, and give an account of tests carried out in 1953 on the effectiveness of infra-red rays for their control in seed peas. The peas were exposed for 1, 2 or 3 minutes in a single layer in an apparatus having seven lamps operated at a distance of 10–12 ins. from the peas and were then transferred to covered boxes and kept at 25°C. [77°F.], a temperature that has been claimed to induce complete emergence of the Bruchids in a fortnight. As few emerged in that period, even in the untreated controls, the peas were immersed in water for 12 hours to induce swelling and germination, and this stimulated emergence, which continued for a further two days. The results showed that irradiation for three minutes gave complete mortality, and that the shorter exposures were ineffective. Irradiation did not decrease the viability of the peas, whereas heat treatments that killed the Bruchids in them reduced germination.

Koehler (W.) & Zdanowicz (Z.). **O zabezpieczeniu niekorowanego surowca sosnowego na składach tartacznych przed szkodliwymi owadami.** [On the Protection of unbarked Pine Logs in Timber Yards from injurious Insects.]—*Roczn. Nauk leśn.* **4** pp. 19–59, 5 figs., 1 graph, 12 refs. Warsaw, 1954. (With Summaries in Russian and English.)

Pine logs in forests and timber yards in Poland are heavily infested by Scolytids unless the bark is removed, and as this process is laborious, investigations were made in 1951–52 on the possibility of replacing it by chemical treatments. Preliminary tests having shown that dusts of DDT, BHC, or both (1:1) were toxic to adults of the genus *Myelophilus* (*Blastophagus*), a survey of timber yards in different parts of the country was carried out in July 1951 to ascertain the beetles responsible for damage. *M.* (*B.*) *piniperda* (L.) and *Ips sexdentatus* (Boern.) were found to be the most important, followed by *I.* (*Orthotomicus*) *proximus* (Eichh.) and Longicorns. As emergence of *M. piniperda* was well advanced and immature adults of *Ips* spp. were already present, the stacked logs were dusted. The results were difficult to estimate, but indicated that the mixture of DDT and BHC gave about 50 per cent. reduction in attack by *Myelophilus*. Similar treatments in 1952 also greatly reduced infestation.

More detailed tests were carried out in 1952 at two widely separated sawmills, treatments being applied to stacks of pine logs in the yards and also to individual logs lying in the forest. A dust containing equal parts by weight of DDT and BHC, prepared by mixing products containing 10 per cent. DDT and 8 per cent. BHC was applied at rates of 27–54 lb. per acre at the time of emergence of *M. piniperda*, and subsequent examination of treated and untreated logs, by removal of the whole of the bark or of strips only, showed that treatment reduced the numbers of new entries by about 50 per cent. The mixture was more effective than its two components separately, but it soon lost its toxicity under the temperature and light conditions of the yards. Its effectiveness was reduced by the addition to it of sodium fluosilicate or calcium arsenate as a stomach poison. Emulsion sprays were more satisfactory, a spray of tar distillate (carbolineum) and

one of creosote reducing infestation by about 40 and 40–70 per cent., respectively, largely owing to their repellent effects. The effectiveness of both was reduced by subsequent dusting with the mixture of DDT and BHC. A proprietary DDT emulsified solution reduced infestation by 59·5 per cent. and showed high toxicity to the beetles, and the reduction was increased to 72–90 per cent. by dusting with sodium fluosilicate within half an hour, while the bark was still wet. The deposits from this combined treatment were still present 100 days later, in spite of rain, and they protected not only against bark-beetles but also against the Longicorns and blue-stain fungi.

In subsidiary tests, the effect was tried of removing the bark from the logs on the outside of the stack only, since these were invariably the most severely infested. This reduced the total infestation by 65–66 per cent. Covering the unbarked stacks with pine branches reduced it by 91·8 per cent., and this figure was not improved by preliminary dusting of the stack with BHC, but the method is not recommended because the use of branches might be dangerous in case of fire.

Karpiński (J. J.). *Centrobia annae* **n.sp. (Hymenoptera, Trichogrammatidae) pasożyt jaj szkodnika leśnego** *Cicadetta montana* **Scop. (piewik górski) z Puszczy Białowieskiej.** [*Centrobia annae*, sp.n., a Parasite of the Eggs of the Forest Pest, *Cicadetta montana* Scop., in the primaeval Forest of Białowieża.]—*Roczn. Nauk leśn.* **4** pp. 61–68, 6 figs. Warsaw, 1954. (With an English Translation (pp. 66–68) and a Summary in Russian.)

Descriptions are given of the adults of both sexes of *Centrobia annae*, sp.n., a parasite of the eggs of *Cicadetta montana* (Scop.) in the forest of Białowieża, in eastern Poland. They emerged in the laboratory in February 1952 from eggs of the Cicadid collected in December 1951, in June 1952 from eggs collected in May 1952, and in April 1953 from eggs collected in June–July 1952. There is only one generation a year, and the period of emergence in the field coincides with that of the host (June–July). The parasite is included in the genus *Centrobia* in spite of certain differences in the structure of the antennae, since the erection of a new genus would require an extensive revision of the Trichogrammatids.

Koehler (W.). **O dwóch formach gatunku osnuja gwiaździsta** (*Acantholyda nemoralis* **Thoms.).** [On two Forms of *A. pinivora* Ensl.]—*Roczn. Nauk leśn.* **4** pp. 69–88, 4 figs., 1 map, 20 refs. Warsaw, 1954. (With Summaries in Russian and English.)

Acantholyda pinivora Ensl. (*nemoralis* (Thoms.)) became increasingly important on pine in Poland before the late war and spread over large areas in outbreak numbers during and immediately after it [*cf. R.A.E.*, A **35** 27]. With a view to determining the best time for the application of control measures, observations were carried out from the beginning of April to the middle of July in 1952 and 1953 in pine forests in Upper Silesia and near Zielona Góra (Grünberg) on the middle Oder, in the course of which differences were found in the bionomics of the sawfly in the two areas. These are described in detail, as they may explain discrepancies in the literature as to the periods of adult and larval activity, which are illustrated in a table.

In Silesia, adult emergence was delayed by cold weather in the spring of 1952 and began on 20th April, the peak was reached on 1st May and the flight was over by 5th May; in 1953, the adults were present from 9th April to 8th May, with a peak on 21st April. On the Oder, the adults were present in 1952 from 4th June until well into July, with a peak on 21st June, and in 1953 (when they were not numerous) the first adults were observed on 18th May in sunny clearings, but pupae were found in the soil until the end of June. The adults were thus active some 4–7 weeks earlier in Silesia than on the Oder, and by the time the larvae in the former area had completed feeding and were descending from the trees to enter the soil, those on the Oder were only just beginning to feed. This difference in phenology was not due to climatic conditions or the state of the trees, and observations in the spring of 1953 on a limited outbreak near Poznań, to the north-east of Zielona Góra, showed that the emergence period there resembled that in Silesia.

There were also differences in the feeding habits of the larvae, those in Silesia, which hatch earlier, feeding on needles of the previous year, which were the only ones available, and those on the Oder, which hatch later, attacking the May shoots at first, whether or not the eggs had been laid on them, and then moving to the old needles. On the Oder, the females showed a greater capacity for flight than those in Silesia, which was probably due to the fact that they emerged with some eggs still undeveloped, whereas those in Silesia contained only mature eggs. This would explain why banding the trees to prevent the adults from reaching the crowns is effective in Silesia, but not on the Oder, where the females reach the crowns without crossing the bands. In Silesia, the adults are numerous every other year, the life-cycle being normally completed in two years and the larval diapause mostly lasting about 22 months, whereas the life-cycle on the Oder presumably requires three years for completion, as recorded in the literature for areas further to the west, the larval diapause lasting about 34 months [*cf.* **35** 27, 329–330].

Examination of material showed that the larvae, pupae and adults from the Oder were somewhat larger than those from Silesia, and there were certain colour differences in the eonymphs and adult females, which are described. It is considered that the examples from the Oder and from Silesia represent two forms of the species, a western form with late adult emergence and an eastern one with early emergence, respectively. The western is considered to be the typical form, and the new name *orientalis* is proposed for the eastern one, but without definition of its systematic status, since the investigations are not yet concluded.

Schnaider (Z.) & Karlikowski (T.). **Z badań nad chemicznym zwalczaniem pędraków.** [Investigations on the chemical Control of Melolonthid Larvae.]—*Roczn. Nauk leśn.* **4** pp. 89–107, 4 figs., 35 refs. Warsaw, 1954. (With Summaries in Russian and English.)

A detailed account is given of large-scale experiments carried out in 1952 in forests and a tree nursery in Poland on the use of chemicals to protect pine seedlings and poplar cuttings from attack by larvae of *Melolontha melolontha* (L.) or *M. hippocastani* F. The following is based on the authors' summary of the results.

Puddling the roots of the pine seedlings, immediately before planting, in a slurry of water, humus and a proprietary powder containing 8·2 per cent. BHC (20 per cent. γ isomer) at the rate of 0·15–0·5 gm. BHC preparation per plant, or in a similar mixture prepared from a material containing 8 per

cent. technical BHC, at 0·2 or 0·3 gm. per plant, considerably reduced the loss of seedlings due to attack by the larvae, but was injurious to the seedlings, some of which died as a result. This loss increased with rise in BHC dosage. Thorough mixing of the proprietary BHC preparation into the soil at the rate of 1·8 gm. per planting hole, alone or with superphosphate at the same rate, gave good protection and had no adverse effect on the plants, those treated with superphosphate being particularly vigorous, but incorporating it into the soil at ploughing time in the autumn preceding planting was ineffective. Watering the planted seedlings with an emulsion of 0·0175 per cent. chlordane at about 9 gals. per 100 plants was effective and did not harm the seedlings, but would not be practicable in view of the large quantities of water required.

In the case of the poplar cuttings, marked protection was obtained by treating the soil prior to planting with the proprietary BHC preparation at the rate of 180 lb. per acre, the soil being dusted with half the amount, dug to a depth of 12 in., dusted with the rest of the insecticide and finally worked over with a cultivator and rake.

Schnaiderowa (J.). **Szkodniki suszu grzybowego.** [Pests of dried edible Fungi.]—*Roczn. Nauk leśn.* **4** pp. 109–123, 10 figs., 24 refs. Warsaw, 1954.

In order to study the bionomics and control of insect pests of dried edible fungi in Poland, samples of infested material were obtained from the main government storehouse. The only insect reared from them was *Tinea granella* (L.), all stages of which are described. In laboratory experiments in which the food was dried *Boletus edulis*, this moth produced two generations a year, the adults emerging in April–May and September–October, but all stages were present simultaneously. At room temperature, the adults lived for 5–10 days. The maximum number of eggs laid per female was 74 at a relative humidity of 70–75 per cent., and the larvae hatched in 8–15 days. At 14–20°C. [57·2–68°F.] and 65–75 per cent. relative humidity, the development of the winter generation lasted about six months, from the beginning of October to the beginning of April. Some of the larvae of the summer generation did not pupate at the normal time in September, but hibernated in cocoons until the second half of March, the adults emerging in April together with those of the winter generation.

The appearance and habits of other insects known to infest dried fungi are briefly described, and the properties of various common fumigants that might be used in the storehouses are reviewed. The most suitable would be a 1:8 mixture of ethylene oxide and carbon dioxide, but as few of the storehouses in Poland are gas-tight, spraying the walls, floors and ceilings with a 10–15 per cent. solution of sodium hydroxide would be more effective. Chloropicrin can be used to fumigate sacks under a tarpaulin or in special chambers.

In tests of heat treatment of infested dried fungi, larvae of *T. granella* were not affected by exposure for 30 minutes to a temperature of 30°C. [86°F.], but they abandoned the fungi at 40°C. [104°F.]. The young larvae died at 49°C. [120·2°F.] and all larvae were killed by exposure to 53°C. [127·4°F.]. The adults and eggs were all killed by exposure to 50 and 55°C. [122 and 131°F.], respectively, for one hour. Heat treatment is therefore recommended. The fungi should be spread out in thin layers and subjected to a temperature of 55°C. for 45–60 minutes, but to ensure complete control of the moth, treatment of storehouses and packing material is also necessary.

Koehler (W.). **Perspektywy wykorzystania dzika w ramach metody biologicznej.** [Prospects of utilising the wild Boar within the Limits of the biological Method.]—*Roczn. Nauk leśn.* **4** pp. 125–140, 2 figs., 5 refs. Warsaw, 1954. (With Summaries in Russian and English.)

An account is given of investigations in Poland in 1952–53 on the value of wild boars in the destruction of larvae, pupae and newly emerged adults of *Acantholyda pinivora* Ensl. (*nemoralis* (Thoms.)) in the soil of pine forests [*cf. R.A.E.*, A **35** 28]. It was found that the boars afford little control unless the sawfly population is high, but that they then give up to about 80 per cent. reduction in numbers, not only by feeding on the insects but also by their burrowing, which kills many of the pupae; similar control was given by ploughing. The activities of the boars were detrimental to parasites of the larvae, but increased the importance of egg parasites. The use of baits to attract the boars is suggested.

Schnaider (Z.). **Szkodniki drzewostanów popożarowych.** [Pests of Forest Stands damaged by Fire.]—*Roczn. Nauk leśn.* **4** pp. 145–162, 19 figs., 15 refs. Warsaw, 1954. (With Summaries in Russian and English.)

Forest fires were common in Poland during and after the late war and favoured the development of numerous insect pests of conifers that were previously not well known to foresters. Notes are therefore given on the appearance, bionomics and control of the more important. These include the Lamiids, *Monochamus sutor* (L.) and *M. galloprovincialis* var. *pistor* (Germ.), which can be controlled by means of trap logs, the Cerambycids, *Criocephalus rusticus* (L.) and *Spondylis buprestoides* (L.), and the Buprestid, *Melanophila acuminata* (Deg.), all on pine, and the wood-wasps, *Urocerus* (*Sirex*) *gigas* (L.), *Sirex* (*Paururus*) *juvencus* L. and *Xeris spectrum* (L.). Pine seedlings planted in burnt-over sites were attacked by *Agrotis vestigialis* (Hfn.) and the weevils, *Cneorrhinus plagiatus* (Schall.), *Strophosomus capitatus* (Deg.) (*obesus* (Marsham)) and *S. melanogrammus* (Först.) (*coryli* (F.)). These can be controlled by dusting the seedlings with a mixture of BHC and DDT.

Batinica (J.) & Čolić (M.). **Gradacija smokvinog medića u Hercegovini.** [An Outbreak of the Fig Coccid in Herzegovina.]—*Plant Prot.* no. 22 pp. 18–23, 3 figs., 6 refs. Belgrade, 1954. (With a Summary in English.)

A severe outbreak of *Ceroplastes rusci* (L.) occurred on fig in Herzegovina in 1950, the stems, branches and fruits being densely covered with the scales and the fruits rendered unfit for consumption. Some of the infested branches dried out and were attacked by the Scolytid, *Hypoborus ficus* Erichs. The adults of *C. rusci* are described, and a brief account of its bionomics is given. There were two generations a year, the second-stage nymphs overwintering. The females oviposited in May, and the crawlers attached themselves along the veins on the upper sides of the leaves and to the fruits. Mature females of the first generation migrated to the branches in July for oviposition, and the crawlers spread to the foliage and fruits, but mostly settled on the branches. In experiments with winter sprays, very good results were given by proprietary preparations of DNC, and the use of the best of these throughout the infested area in the winter of 1952–53 controlled the outbreak, mortality averaging 95–99 per cent.

Ilić (B.). *Ceuthorrhynchus suturalis* **Fabr., malo poznata štetočina crnoga luka u Srbiji.** [*C. suturalis* a little-known Pest of Onion in Serbia.]—*Plant Prot.* no. 22 pp. 30–37, 2 pls., 8 refs. Belgrade, 1954. (With a Summary in English.)

Ceuthorrhynchus suturalis (F.) was found infesting onions in south-eastern Serbia in 1949, for the first time in Yugoslavia and a survey in 1953 showed that the weevil was present throughout Serbia, except for the northern district of Voyvodina. It was most abundant along the frontier with Bulgaria, in which country it is widely distributed. Serious damage was caused in 1952 and 1953. All stages of the weevil are described, and an account is given of observations on its bionomics, carried out chiefly near Pirot. There was only one generation a year, the life-cycle being similar to that recorded from Germany [*cf. R.A.E.*, A **28** 162]. The over-wintered adults were first seen in large numbers in the field at the end of April on self-sown onions, but the simultaneous presence of eggs and larvae in the leaves indicated that they must have emerged from hibernation at the beginning of the month. Adults were most abundant on cultivated onions in mid-May. They fed on the leaves and oviposited in the inner tissues, chiefly in the topmost part, causing the appearance of irregular spots and twisting of the leaves. The larvae hatched in 7–10 days and bored in the leaves, the injury resembling that caused by a mining insect. As up to 20 larvae occurred in a single leaf, the cumulative effect was considerable, especially in a year of drought. The outer leaves were more heavily infested than the inner ones, and the central leaf, which is coarse and unsuitable for oviposition, was not attacked. The larval stage lasted about three weeks, and both eggs and larvae occurred in the leaves until mid-June. Pupation occurred in the soil, and the pupal stage lasted 15–20 days. Towards the end of June, the adults of the old generation died out and those of the new one appeared, but were sexually immature.

In small-scale tests on control, a proprietary parathion spray had no effect on the eggs and larvae in the leaves, but gave good control of the adults.

Jovanić (M.). **Pojava i štetnost lucerkinih mušica u Vojvodini.** [The Occurrence and Injuriousness of Lucerne Midges in Voyvodina.]—*Plant Prot.* no. 22 pp. 100–102, 3 figs., 5 refs. Belgrade, 1954. (With a Summary in English.)

Lucerne in the Voyvodina district of northern Serbia was attacked in 1953, in descending order of intensity, by *Dasyneura ignorata* (Wachtl), *Contarinia medicaginis* Kieff. and *Asphondylia mikii* Wachtl, and the first two of these Cecidomyiids had also been recorded in 1949 and 1950. *D. ignorata* occurred in large numbers and infested 100 per cent. of the plants in some places. The development of a complete generation lasted 35 days in the laboratory, and as larvae were found in the field from the end of May to October, there are probably 3–4 generations a year. The full-fed larvae of the last generation hibernated in the soil. Galls, each containing 5–6 larvae, were formed on the lateral shoots, causing dropping of the leaves and retarding growth. *C. medicaginis* infested 50 per cent. of the plants in some localities. The larvae were present from about 10th June to the end of September and attacked the flower buds, in which they destroyed the immature stamens. The buds became swollen at the base, each containing up to ten or more larvae, and infestation was heaviest on lucerne grown for seed after the second mowing. Larvae of *A. mikii* were observed in July and August causing deformation and hardening of the pods. Infested pods contained 5–6 larvae each and produced no seed.

Schvester (D.). **Le xylébore disparate,** *Anisandrus dispar* **F. (coléoptère scolytide) en France.**—*Ann. Epiphyt.* **5** (1954) no. 3 pp. 225–257, 5 figs., 25 refs. Paris, 1955.

Most of the information in this detailed description of observations on the distribution, bionomics and control of *Xyleborus* (*Anisandrus*) *dispar* (F.) on fruit trees in France has already been noticed from briefer accounts [*R.A.E.*, A **43** 26, 371]. Development from egg to adult was completed in about 55–60 days at 25°C. [77°F.] and about three months in the field, although there was only one generation a year [**43** 371], and the females laid up to 60 eggs each.

Wellenstein (G.). **Was können wir von der Roten Waldameise im Forstschutz erwarten?** [What can we expect from the Red Forest Ant in Forest Protection?]—*Beitr. Ent.* **4** no. 2 pp. 117–138, 4 figs., 58 refs. Berlin, 1954.

Formica rufa L. has frequently been considered of value in the destruction of forest pests [*cf. R.A.E.*, A **42** 60, etc.], but exact data as to its importance are lacking. From a study of the European literature of the past 155 years, the author shows that the ant has been mentioned as a control factor in 93 out of 210 records of pest outbreaks and in 70 out of 141 in which the pests were Lepidoptera. Protection of the trees was afforded, though possibly only over small areas, in 76 of 100 cases and in 62 of 75 in which Lepidoptera were concerned. Sawflies were reduced to a much smaller extent than were Lepidoptera, and Coleoptera hardly at all. The effectiveness of the ant is usually reckoned according to the number of insects carried to the nests, but this affords no information as to the pest populations remaining. In investigations in pine forests in Germany in which the trees had been attacked by *Diprion pini* (L.), the soil at various distances up to about 44 yards from five nests of the small form (*minor*) of *F. rufa rufopratensis* Forel [*cf.* **35** 212] was searched for insects and other arthropods, and sheets covered with adhesive were spread to catch the larval excreta and exuviae and any insects that alighted on them. The results are given in detail in tables. The nests were of different sizes and ages, and the large colonies were naturally the more effective, but there were reductions in all cases in the numbers of most insect groups as the nest was approached from the periphery of the sampling area. The reductions were greatest for Lepidopterous larvae and small Diptera. Predacious insects were also reduced in numbers, but *D. pini* and other sawflies were less affected. Protection was not in general afforded for more than about 25 yards from the nest, so that a series of nests over an area is desirable for the best results.

Becker (H.). **Beiträge zur Kenntnis des Rebstichlers** (*Byctiscus betulae* **L.).** [Contributions to Knowledge of *B. betulae*.]—*Beitr. Ent.* **4** no. 2 pp. 158–172, 8 figs., 12 refs. Berlin, 1954.

Byctiscus betulae (L.) is an important pest of grape vines in Germany, especially in the Palatinate. The adults appear in spring and feed on the leaves and occasionally on the young berries, and the females lay their eggs in rolled leaves, of which they partially cut the petioles. Such leaves dry up and fall to the ground. The larvae complete their development in the fallen leaves and pupate in the soil. Some adults emerge in late summer and overwinter without reproducing, and the rest of the population overwinters in the larval stage.

In laboratory investigations on the effect of environmental factors on the development of this weevil, eggs kept at various temperatures and 92 per cent. relative humidity hatched in 3–4 days at 29°C. [84·2°F.] and completed their development at 32°C. [89·6°F.], though mortality was then high. Relative humidity had little effect, but hatching was prevented if it was very low. Low temperature mitigated the effect of low humidity. The larvae developed best in a saturated atmosphere, weight increase being reduced in comparison even at a relative humidity of 90 per cent. and actual weight falling at 17 per cent. A temperature of 25°C. [77°F.] was the most favourable, and death ensued at 30 or 5°C. [86 or 41°F.]. The larvae are known to feed on the numerous micro-organisms that attack the fallen leaves, but they developed normally in the laboratory on sterilised leaves, although they then lacked the intestinal flora of larvae in nature. Such flora can thus be of no importance for development. The hydrogen-ion concentration of the soil was also without effect on development. The digestive tract of the larva is described, and observations on the hydrogen-ion concentration of its various sections in fed and unfed individuals are recorded; in no case was this below pH 5.

Sachtleben (H.). **Parasiten der Möhrenfliege,** *Psila rosae* **Fabr.** [Parasites of the Carrot Fly, *P. rosae*.]—*Beitr. Ent.* **4** no. 2 pp. 219–220, 6 refs. Berlin, 1954.

Parasites reared from the carrot fly, *Psila rosae* (F.), near Kiel in 1953 were found by the author to comprise the Braconid, *Dacnusa gracilis* (Nees), the Cynipid, *Rhynchacis nigra* (Htg.), and the Diapriid, *Loxotropa tritoma* (Thoms.). Previous records of these species from *P. rosae* are reviewed [*cf. R.A.E.*, A **35** 213].

Dunn (J. A.). *Micromus variegatus* **Fabricius (Neuroptera) as a Predator of the Pea Aphid.**—*Proc. R. ent. Soc. Lond.* (A) **29** pt. 4–6 pp. 76–80, 1 pl., 1 graph, 3 refs. London, 1954.

The author records observations showing that *Micromus variegatus* (F.) was an important predator of *Macrosiphum* (*Acyrthosiphon*) *pisum* (Harris) in a small field of lucerne surrounded by trees and high hedges in central England in 1952, though it was absent from more open fields and had been found attacking the Aphid on leguminous forage crops only twice, in 1949, in earlier surveys. In observations on this Hemerobiid, of which both the larvae and adults are predacious, females collected on 24th July oviposited on a bean plant infested by *M. pisum* and on the upper walls and top of the cage confining them; on 30th July, the eggs were transferred to a constant temperature of 45°F., which delayed hatching, for up to 21 days in the case of freshly deposited ones, and reduced larval activity until food was available. The larvae were reared at temperatures of 45–60°F. and young Aphids were supplied as food. The duration of the larval stage varied from about 15 days at 60°F. to 35 at 45°F.; mortality was high and occurred mostly during the inactive periods between moults. The mean daily consumption of *M. pisi* during development increased from 0·66 second-instar Aphids on the first day to eight third-instar Aphids on the last at 45°F. and from 2 to 16 at 60°F. The total number of Aphids destroyed during development varied from 54 to 82 according to the completeness with which they were consumed; it was not affected by temperature. Pupation took place in loose cocoons, and the pupal stage lasted for an average of 34 days at 55°F.; few adults emerged. Total

development appeared to require about 7–8 weeks at 60°F. In the field, three generations can probably develop during the year, provided that temperatures are about the average and high in September and there is an adequate food-supply, oviposition taking place about May, about July and from mid-September.

Barnes (H. F.). **The Shasta Daisy Midge and other Insects in Flowers of *Chrysanthemum* Species.**—*Plant Path.* **2** no. 2 pp. 52–53. London, 1953.

Contarinia chrysanthemi (Kieff.) was recently found infesting Shasta daisy (*Chrysanthemum maximum*) in Northumberland, and the bionomics of this Cecidomyiid, its distribution on wild ox-eye daisy (*C. leucanthemum*), and its potentialities as a pest of other cultivated species of *Chrysanthemum* were investigated in 1952, when it was also observed on Shasta daisy in Lincolnshire, Staffordshire and Dublin. In food-plant tests, females reared from Shasta daisy oviposited in the flower buds of *C. carinatum* (annual chrysanthemum), *C. cinerariaefolium*, *C. frutescens* (marguerite), *C. leucanthemum* and Sweetheart chrysanthemums. Larvae from Shasta daisy kept in soil from the beginning of August 1951 gave rise to adults in late November and early December at room temperature and between 19th May and 30th June 1952 in an unheated insectary; the ratio of males to females in May–June was 27:73. Larvae on Shasta daisy received from Newcastle on 25th June 1952 gave rise to adults between 29th July and 8th September, and others on wild ox-eye daisy received from Anglesey on 6th June did so between 29th July and 28th August. Examination of samples of wild ox-eye daisy received in 1952 showed that *Contarinia chrysanthemi* was widely distributed on that plant in southern England. Lists are given of other insects reared from it; they include *Misospatha* (*Rhopalomyia*) *hypogaea* (F. Lw.) [*cf. R.A.E.*, A **31** 282], which oviposited on a variety of Shasta daisy in preliminary tests.

Moreton (B. D.), Light (W. I. St. G.) & John (M. E.). **Experiments on the Control of Cabbage Root Fly.**—*Plant Path.* **2** no. 3 pp. 82–84. London, 1953.

Various concentrations of several recently developed insecticides were compared against *Hylemyia* (*Erioischia*) *brassicae* (Bch.) on cabbage in southern England in 1952, when infestation became severe and drought conditions provided a good test of phytotoxicity. In a test in which cabbage plants were dipped up to the lower leaves in 0·5, 1, 5 and 10 per cent. wettable γ BHC, dieldrin and toxaphene on 27th May, immediately prior to planting out, all materials caused a severe check to growth at 10 per cent., owing to root injury, and were injurious at 5 per cent. At harvest, the mean percentages of marketable cabbages were 94, 83 and 84 for 0·5 per cent. of the three materials, respectively, 94, 77 and 94 for 1 per cent., and 81, 76 and 86 for 5 per cent., as compared with 64 per cent. for water only; the yield from plants treated at 10 per cent. was considerably reduced. In another test, the yield percentages from plants dipped in 0, 0·5, 1, 4 and 7 per cent. γ BHC were 55, 88, 78, 83 and 60, respectively.

In a test of sprays applied in a 3-inch band along the rows at the base of the plants, wettable γ BHC, parathion and emulsion concentrates of aldrin and dieldrin were applied at various concentrations and rates on 1st May, when eggs were abundant, and again three weeks later to half of each plot; the second application produced no significant difference in the

results. The highest yield of marketable cabbages (78 per cent.) was obtained in plots treated with γ BHC at 2·3 lb. in 460 gals. water per acre or with dieldrin at 2·3 lb. in 230 gals., which were significantly superior to the controls and to γ BHC at 1·15 lb. in 115 or 230 gals. or 0·46 lb. in 460 gals., and to dieldrin at 1·15 lb. in 230 gals., but not to 2·3 lb. γ BHC or aldrin in 230 gals., 4·6 lb. γ BHC in 460 gals. or 1·15 lb. aldrin in 230 gals.; γ BHC at 0·58 lb. in 115 gals. and 0·23 lb. in 230 gals. and parathion at 0·58 lb. in 230 gals. were ineffective. It is concluded that the amount of γ BHC required for maximum control is about 2 lb. per acre with rows 2 ft. apart; no conclusions could be reached as to the effect of the amount of water used. In a discussion of cost of treatment with γ BHC, it is stated that the root dipping method, in which each plant retains about 1 cc. liquid, is considerably less costly than row treatment, since one gallon is sufficient for up to 5,000 plants. The cost is reduced to about one-fifth if toxaphene is substituted for γ BHC.

Nuorteva (P.). **Studies on the salivary Enzymes of some Bugs injuring Wheat Kernels.**—*Ann. ent. fenn.* **20** no. 3 pp. 102–124, 10 figs., 43 refs. Helsinki, 1954.

In view of the finding that the mechanical injury caused to wheat grains by the feeding of cereal bugs is not responsible for the loss of baking quality that sometimes results, and the suspicion that this is due to the injection of proteolytic enzymes [*cf. R.A.E.*, A **42** 61], the salivary enzymes of various Mirids and Pentatomids that puncture wheat kernels in Finland were investigated. The methods used in determining them are described, and the following is based on the author's summary of the results.

The salivary glands of the adults of *Lygus rugulipennis* Popp. contained amylases but no proteases or lipases, whereas those of the nymphs contained both amylases and proteases. Proteases degrade the baking quality of the wheat, and kernels injured by both adults and nymphs in breeding cages showed increased proteolytic activity. Under field conditions, the nymphal stage is completed before the wheat ears emerge, and this Mirid does not, therefore, in practice affect the quality of the grain [*cf.* **43** 339]. The increased amounts of maltose observed in kernels injured by *L. rugulipennis* is undoubtedly caused by the salivary amylases. The extracted oral secretions of the adults had no effect on baking quality. The salivary glands of *Adelphocoris lineolatus* (Goeze) contained amylases and proteases, and those of *Capsus ater* (L.) amylases acting at pH values of 5·4–8; proteases were found in the salivary glands of examples of the latter from oats but not in those from grasses.

Amylases and proteases, but no lipases, were found in the salivary glands of *Miris dolabratus* (L.); the pH optimum of the proteases seemed to be between 6·4 and 7·6. Tests of the rapidity of action of the enzymes of this species were made with and without the addition to the substrate of minute amounts of sap from wheat stems so as to test the significance of any enzyme activators present in the plant. No protease action appeared in digestion times of less than an hour whether the sap was added or not, and since similar studies of amylase action after periods of 20 and 45 minutes, which exceed the normal feeding time at any one spot, showed no traces of digestion, it is concluded that external digestion by the saliva does not occur in this species. Kernels injured by *M. dolabratus* in breeding cages showed increased proteolytic activity.

The salivary proteases detected in *Notostira erratica* (L.) and the amylases and proteases in *Stenodema calcarata* (Fall.) were comparatively ineffective. A salivary protease acting in neutral or slightly acid media and an amylase

were observed in *Dolycoris baccarum* (L.); kernels injured in breeding cages by this species showed increased proteolytic activity. There were unusual colour differences between the two lobes of the principal salivary gland in *Aelia acuminata* (L.); proteases and amylases were present in both, but whereas the enzymes of the anterior lobe were active in a slightly acid medium but not in a neutral one, those of the posterior lobe were active in both.

Brenière (J.). **Deux ennemis du riz dans la vallée du Niari.**—*Agron. trop.* **9** no. 1 pp. 37–40, 5 figs., 13 refs. Nogent-sur-Marne, 1954.

Crops are being grown over a considerable area of the Niari Valley, near Brazzaville in the territory of the Middle Congo, and dry-land rice sown on newly cleared land in October 1951 and 1952 was destroyed almost completely as it appeared above ground by larvae of *Laphygma exempta* (Wlk.). These appeared suddenly in large numbers at the beginning of the rainy season and were present for about a fortnight. The larvae were heavily parasitised, and the parasites were identified as *Euplectrus laphygmae* Ferrière, *Disophrys lutea* (Brullé) and *Macrocentrus fuscicornis* Szépl. The literature on these is briefly reviewed, and a table is given showing all the known parasites of *L. exempta* and their distribution. The young rice plants were also attacked by adults of the Tenebrionid, *Dasus* (*Gonocephalum*) *simplex* (F.). Measures for the control of both pests are reviewed.

Descamps (M.). **Insectes nuisibles aux cultures et insectes prédateurs récemment observés dans le Nord Cameroun.**—*Agron. trop.* **9** no. 2 pp. 174–182. Nogent-sur-Marne, 1954.

A table is given showing the insects found attacking crop plants in the North Cameroons in 1951–52, arranged under the species or family of plants attacked, together with very brief notes in some cases on their importance and other food-plants. This is followed by a list of the predacious insects observed, showing their abundance and the insects attacked.

Lefèvre (P. C.). **Étude de** *Calandra oryzae* **L. sur sorgho** (*Sorghum vulgare* **Brot.**).—*Bull. agric. Congo belge* **44** no. 5 pp. 1001–1046, 6 figs., 58 refs. Brussels, 1953. (With a Summary in Flemish.)

Sorghum is an important food-crop in the Kivu Province of the Belgian Congo, and the stored grain is severely infested by the small strain of *Calandra oryzae* (L.) [*R.A.E.*, A **34** 21, etc.]; the growing crop is also attacked. The distribution of this weevil, the plants or stored products that it damages, and its bionomics, parasites and control are briefly reviewed from the literature, and an account is given of laboratory studies in 1951–52 on its bionomics and control in stored sorghum.

At 18–24°C. [64·4–75·2°F.] and 44–45 per cent. relative humidity in the laboratory, the life-cycle from egg to egg in grain of 11·81–12·23 per cent. moisture content averaged almost 54 days, and it is concluded that there are probably 6–7 overlapping generations a year. Males survived for 12–122 days, with an average of 70·2, and females for 51–122 days, with an average of 83·9. The numbers of eggs laid per female ranged from 112 to 512 and averaged about 375, and batches averaging about 12 were deposited at intervals averaging 2·65 days. The two sexes were about equal in numbers. When kept without food, males and females survived for a maximum of 19 days; no cannibalism occurred.

To study the course of infestation, 12 jars each containing about 8 lb. infested sorghum that had been previously kept for 15 days at −3°C. [26·6°F.] were each infested with 20 pairs of newly emerged adults in January 1951, and 12 left without supplementary infestation. A different jar from each series was examined each month, and the percentages of undamaged grains and the numbers of adults per random sample of 100 gm. (referred to throughout as the incidence of adults) in the artificially infested and (in brackets) the control series were 100 (100) and 4·23 (1·95), respectively, after one month, 95·24 (99·16) and 6·7 (3·35) after three months, 77·26 (97·91) and 207·58 (14·69) after six months, 25·42 (84·75) and 922·04 (103·24) after nine months, and 13·68 (72·55) and 963·71 (381·5) after 12 months. It was thus evident that exposure to −3°C. had not killed all the weevils in the grain. Observations were also made on sorghum stored in two native granaries at about 5,700 and 6,800 ft., respectively. The percentages of undamaged grains and (in brackets) the incidence of adults were 92·13 (155·87) and 96·26 (28·9), respectively, three months after harvest, 5·47 (722·45) and 19·36 (692·54) six months after harvest, and 0·02 (1,119·2) and 0·59 (1,416·93) 12 months after harvest. The percentages of living adults varied from about 90 to 16 and diminished as the period of storage increased.

The products used in the tests on control were powders containing 1 per cent. γ BHC or 2·5, 5, 7 or 10 per cent. technical DDT, pyrethrum powder containing 1·403 per cent. pyrethrins, a powder containing 0·05 per cent. pyrethrins and 0·8 per cent. technical piperonyl butoxide and an inert dust (diatomaceous earth). These were mixed with undamaged sorghum, and samples of 50 treated and 50 untreated grains placed in petri dishes with five pairs of adults in each. The dishes were examined daily, and the numbers of days required to give complete mortality were 6 and 24 for the BHC product at rates of 0·1 and 0·01 per cent. by weight, 23, 22, 10, 10 for the four DDT powders, respectively, at 0·1 per cent., 11 for the pyrethrum powder at 0·5 per cent., 30 for the mixture of pyrethrins and piperonyl butoxide at 0·1835 per cent., and 49 for the inert dust at 0·25 per cent.; all the weevils were alive in untreated grain after 49 days.

In further tests, with sorghum harvested on 15th February 1951, flasks were filled with 300 gm. treated or untreated grain on 15th April and examined monthly from May 1951 to February 1952, and the products were simultaneously incorporated by hand into sorghum that was stored in bags containing about 110 lb., which were suspended in a storehouse without contact with one another and sampled monthly over the same period, samples of about 6·6 lb., which were found sufficient for an accurate estimate of infestation, being taken by means of a probe. The results of both tests are given in tables showing the percentages of damaged and undamaged grains, the percentage of refuse and the incidence of adults. On 15th August and 15th February, the percentages of undamaged grain in the flasks and (in brackets) in the sacks were 31·97 (13·96) and 5·24 (5·23) for no treatment, 46·27 (70·3) and 0 (30·42), 79·9 (88·12) and 16·94 (59·1), and 81·93 (90·2) and 71·27 (75·62) for the BHC powder at 0·01, 0·05 and 0·1 per cent., respectively, 74·94 (80·27) and 18·18 (49·92), 93·22 (89·19) and 41·95 (62·47), 95·1 (90·52) and 70·4 (71·94), and 88·73 (87·57) and 70·18 (70·97) for the four DDT powders, respectively, at 0·1 per cent., 87·03 (92·19) and 12·24 (65) for the pyrethrum powder at 0·5 per cent., 20·59 (22·46) and 0·66 (1·05) for the mixture of pyrethrins and piperonyl butoxide at 0·1835 per cent. and 36·47 (45·38) and 0 (3·9) for the inert dust at 0·25 per cent. Counts of the adults a year after the beginning of the experiment showed that the percentages alive were about 65·7 for no treatment, 29·3, 1·6 and 0 for the BHC powder at the three rates, respectively, 3·8, 2·5, 0·5

and 0 for the DDT powders, respectively, 14·4 for the pyrethrum powder, 21·3 for pyrethrins and piperonyl butoxide and 15·9 for the inert dust. Subsidiary investigations showed that none of the treatments affected the viability of the grain. The cost of the insecticides is discussed, and it is concluded that treatment is uneconomic if the grain is not to be stored for longer than three months.

Untreated sorghum of four different varieties was stored in sacks under the same conditions for a year, and the percentages of damaged grains and the incidence of adults from September 1951 to July 1952 were recorded. The two varieties that are the most widely grown in Kivu showed a slightly higher percentage of damaged grains than two from Ruanda, and studies on varietal resistance in sorghum are recommended.

Geering (Q. A.). **A Cotton Stainer** (*Dysdercus superstitiosus* **Fabr.**) **as a potential Pest of Sorghum.**—*Emp. J. exp. Agric.* **20** no. 79 pp. 234–239, 10 refs. Oxford, 1952; also in *Res. Mem. Emp. Cott. Gr. Corp.* no. 17. London, 1953.

The following is substantially the author's summary. Early workers in southern Nigeria recorded adults of *Dysdercus superstitiosus* (F.) feeding, but not breeding, on bulrush millet (*Pennisetum typhoides*) and sorghum [*cf. R.A.E.*, A **16** 234]. This cotton stainer was noted breeding on bulrush millet in northern Nigeria during 1948–50, and a severe attack, due to extensive breeding, occurred on a large crop of dwarf sorghum in 1950. The conditions under which this outbreak occurred are described, and its probable causes indicated.

The field evidence suggests that in northern Nigeria the indigenous peasant variety of sorghum, a tall late-maturing type that is grown exclusively for food, may be resistant to *Dysdercus* breeding, but the dwarf variety appears to be particularly susceptible. In Uganda, the author has bred *D. superstitiosus* through its complete life-cycle on dwarf varieties obtained from the Eastern Province of that territory. The significance of this apparent change in the behaviour of *D. superstitiosus* is discussed, with particular reference to new or established sorghum-growing areas in other African territories.

Schmidt (H.). Ed. **Die Termiten. Ihre Erkennungsmerkmale und wirtschaftliche Bedeutung.** [Termites. Their Characteristics and economic Importance.]—9 × 6¼ ins., 309 pp., 120 figs., many refs. Leipzig, Geest & Portig K.-G., 1955. Price *DM.* 32.

In addition to an introduction by the editor and accounts of the body structure, systematics and distribution of termites, by H. Weidner (pp. 5–81, 40 figs., 71 refs.), termite nests, by the same author (pp. 82–120, 20 figs., 26 refs.), and swarming and the foundation of colonies by termites, by A. Herfs (pp. 121–130, 4 figs., 13 refs.), this book contains the following sections:—

Herfs (A.). **Termite und Pflanze** [Termite and Plant], pp. 131–159, 26 figs., 31 refs. The importance of termites as pests of living plants, largely trees, is reviewed, the reactions of laboratory colonies of *Reticulitermes lucifugus* (Rossi) to various common fruits and vegetables grown in Germany are described, and the relation of termites to the plants that grow on their nests in Africa and other regions and the significance of termites in soil-formation are discussed.

Weidner (H.). **Bekämpfung der pflanzenschädlichen Termiten** [The Control of Termites injurious to Plants], pp. 160–164, 11 refs. This is a review of methods of freeing newly cleared land from termites and of protecting plants from attack by the use of soil or seed treatments, fumigants for application to the nests, or poison baits.

Gösswald (K.). **Die Gelbhalstermite** (*Calotermes flavicollis* **Fabr.**) **als Versuchstier** [*Kalotermes flavicollis* as an experimental Insect], pp. 165–192, 6 figs., 39 refs. Methods are described for rearing *Kalotermes* (*Calotermes*) *flavicollis* (F.) in the laboratory and using this termite in tests of the resistance of various materials to attack and the effectiveness of proofing treatments [*cf. R.A.E.*, A **40** 13].

Schmidt (H.). **Termitenangriff und Holz, mit besonderer Berücksichtigung des Bau- und Werkholzes** [Termite Attack and Wood, with special Reference to structural Timbers, etc.], pp. 193–207, 5 figs., 52 refs. The damage done to structural timbers and articles made of wood in various parts of the world by termites is reviewed, and methods of preventing it are briefly discussed. These include impregnation with chemicals, the use of specially prepared termite-resistant composition panels or plywood and naturally termite-resistant timber, and soil treatment with DDT or other insecticides round buildings.

Sandermann (W.). **Chemische Grundlagen der Holzschutzmittel gegen Termiten und ihre Anwendungsverfahren** [The chemical Basis of Wood Protectants for Use against Termites and Methods of Application], pp. 208–244, 19 figs., 75 refs. The author briefly reviews the compounds that have been found responsible for the natural resistance of certain timbers to termite attack, gives tables showing the composition and properties of the substances used for the protection of wood against it, discusses their effectiveness and use, largely from the literature, outlines chemical methods of detecting their presence, and describes the various techniques that are used for the impregnation of timber.

Bavendamm (W.). **Natürliche Dauerhaftigkeit der Hölzer gegen Termitenfrass** [Natural Resistance of Timbers to Termite Attack], pp. 245–306, 71 refs. Investigations in various parts of the world on the natural resistance of the wood of different trees to attack by termites are reviewed, the results are summarised in a table, and an alphabetical list is given of termite-resistant woods arranged under plant families, with indications of those that are in commercial use.

Ward (J.). **Separation of the " Pyrethrins " by displacement Chromatography.**—*Chem. & Ind.* 1953 pp. 586–587, 1 graph, 8 refs. London, 1953.

Chromatographic methods have been employed for the separation of pyrethrin I and cinerin I from pyrethrin II and cinerin II [*cf. R.A.E.*, A **41** 336], and an account is here given of investigations in which displacement chromatography was used to separate these four main constituents of pyrethrum extract from one another and from certain impurities present in the extract after purification by the nitromethane method [**33** 189].

The biological activity of each of these four fractions from the column was determined by topical application of a drop (1 μl.) of solution in acetone to *Phaedon cochleariae* (F.). The median lethal concentrations, determined graphically and expressed as per cent. w/v, were 0·001 for pyrethrin I, 0·002 for cinerin I, 0·0026 for pyrethrin II and 0·005 for cinerin II, as compared with 0·025 for allethrin.

Winteringham (F. P. W.), Harrison (A.), Bridges (R. G.) & Bridges (P. M.). **The Fate of labelled Insecticide Residues in Food Products. II. The Nature of Methyl Bromide Residues in fumigated Wheat.** —*J. Sci. Fd Agric.* **6** no. 5 pp. 251–261, 5 figs., 32 refs. London, 1955.

Bridges (R. G.). **III. *N*-Methylation as a Result of fumigating Wheat with Methyl Bromide.**—*T.c.* pp. 261–268, 2 figs., 28 refs.

Winteringham (F. P. W.). **IV. The possible toxicological and nutritional Significance of fumigating Wheat with Methyl Bromide.**—*T.c.* pp. 269–274, 36 refs.

The following are the authors' summaries of these three parts of a series [*cf. R.A.E.*, A **40** 31].

The chemical fate of methyl bromide absorbed by wheat under the conditions of fumigation has been studied. Whole-wheat flour was exposed to ^{14}C-labelled methyl bromide. The fat, starch, gluten and water-soluble fractions were prepared from the exposed flour and their ^{14}C-content assayed. The gluten or protein fraction was responsible for some 80 per cent. of the decomposition of the absorbed fumigant. By measuring the ^{14}C of the volatile products obtained on treating the gluten with sodium hydroxide or hydriodic acid under different conditions, it was shown that the decomposition of methyl bromide in gluten was due almost entirely to methylation with the formation of 50 per cent. of N-methyl derivatives, 30 per cent. of dimethyl sulphonium derivatives, and of 20 per cent. of methoxyl and thiomethoxyl derivatives in about equal proportions. Similar results were obtained when gluten alone was exposed to the labelled fumigant. The production of free methanol in the flour by hydrolysis of the absorbed fumigant was about 10 per cent. or less. The rate of spontaneous decomposition of the dimethyl sulphonium compounds formed as a result of fumigation was estimated by using wheat which had been grown on ^{35}S-labelled sulphate.

The principal reaction between ^{14}C-labelled methyl bromide and the nitrogen-containing groups of wheat protein has been shown, by combined radioactive tracer-chromatographic techniques, to be with the histidine residue. Three methylated histidines are present in the hydriodic acid hydrolysate of the protein that has been exposed to methyl bromide, and these have been identified as 1-N-methylhistidine, 3-N-methylhistidine and 1,3-N-dimethylhistidine. The amount of reaction occurring under typical fumigation conditions is so small that the loss of the semi-essential amino-acid, histidine, is negligible.

The major products of the chemical reactions between methyl bromide and the constituents of wheat under the conditions of fumigation have been characterised or identified. Their rate of absorption by an adult human consuming fumigated flour products has been estimated. The likely nature of the effective end-products of human digestion has been considered and is believed to be represented by the compounds methanol, methylglucoses, S-methylcysteine, methyl methionine sulphonium salts, and N-methyl derivatives of histidine and lysine. These appear to be compounds which have been fed experimentally to mammals at concentrations very much larger than those likely to obtain in fumigated wheat. In some cases their metabolism *in vivo* has also been studied. On the basis of all the available data an appraisal has been made of the toxicological and nutritional significance of consuming fumigated flour products. There is no evidence that the principal fumigant decomposition products are toxic or that their formation would be associated with any significant reduction in essential food constituents.

Hayward (L. A. W.). **Losses associated with Groundnuts infested with *Trogoderma granarium* Everts.**—*J. Sci. Fd Agric.* **6** no. 6 pp. 337–340, 5 graphs, 1 ref. London, 1955.

Shelled groundnuts stored in sacks in Nigeria are liable to attack by insects, of which *Trogoderma granarium* Everts is one of the most important [*cf. R.A.E.*, A **40** 200]. As it was desired to ascertain to what extent measurement of the frass produced by this Dermestid could be used to assess total damage by it, a laboratory experiment was carried out at Kano in which uninfested groundnuts, either whole or broken, were infested with larvae of *T. granarium* and kept for over a year in jars. The dry weight of the frass produced was found to be about equal to the fall in total dry weight, and the loss of edible nut is thus about equal to twice the frass weight.

Higgons (D. J.) & Kilbey (D. W.). **Colorimetric Analysis of *p*-Chlorobenzyl *p*-Chlorophenyl Sulphide (Chlorbenside) Residues in Plant and Animal Tissue.**—*J. Sci. Fd Agric.* **6** no. 8 pp. 441–448, 3 graphs, 5 refs. London, 1955.

The following is the authors' summary. A method is described for the colorimetric analysis of residues of p-chlorobenzyl p-chlorophenyl sulphide on leaf and fruit samples and in animal tissue. The method is based on pre-oxidation of the spray residues followed by intensive nitration of the resulting p-chlorobenzyl p-chlorophenyl sulphone, and the formation of a purple colour on interaction of the nitrated products in benzene with sodium methylate. The method is sensitive to 0·05 mg. and is specific in the presence of all likely contaminants except DDT.

McIntosh (A. H.). **Particle Size of insecticidal Suspensions and their Contact Toxicity. V. Effect of physical Properties on Toxicity of Compounds in the DDT Group.**—*Ann. appl. Biol.* **43** no. 2 pp. 161–181, 43 refs. London, 1955.

The following is based on the author's summary of the work described in this part of a series [*cf. R.A.E.*, A **40** 144], in which the compounds used were p,p′DDT, six analogues of it in which the substituents were in the para-positions (bromo-DDT, n-butoxy-DDT, ethoxy-DDT, fluoro-DDT, methoxy-DDT and methyl-DDT), p,p′DDD, p,p′ethyl-DDD, and 1,1-bis(p-chlorophenyl)-2-nitropropane. Aqueous suspensions of two types were prepared from each, one containing crystals of uniform size, and the other containing colloidal particles. The toxicities of each pair of suspensions were compared by a dipping method using adults of *Oryzaephilus surinamensis* (L.), which were kept at 11°C. [51·8°F.] for 24 hours after treatment. The colloid was always as toxic as the crystals, and was more toxic in all except fluoro-DDT, the difference varying from one analogue to another.

The amounts of poison retained by the dipped insects were found by extraction and microanalysis for as many compounds as possible. Retention of poison from colloidal suspension was about the same for each, but crystals were retained either more or less efficiently than colloid, depending on their size and shape. The poorest retention was shown by plate-like crystals of about 25 μ.

The true ratio of toxicities for each analogue (colloid:crystals) was found by correcting the observed or (in the case of the unanalysable compounds) the

estimated ratios for differences in retention, but big differences still remained among the ratios for the different analogues. The true ratio was taken as a measure of the difference in speed of action between the two forms of poison. If the compound could kill *O. surinamensis* by fumigant action alone, as in fluoro-DDT, the true ratio was very small. Otherwise, it seemed to depend on two physical properties related to the process of solution of poison in the wax of the insect cuticle, crystallisation from colloid suspension and solubility of crystal deposits in olive oil. If the film of crystals brought about saturation of olive oil slowly and if, in addition, the deposit from colloid crystallised slowly, the true ratio was large. Unless the analogue had both these properties, the true ratio was small. If the analogue had one or other of the properties, the true ratio could be increased either by increasing the crystal size or by decreasing the rate of crystallisation.

Physical properties of this sort may often affect the results of tests of insecticides, and should be taken into account when the toxicities of different compounds are compared. There seems to be no relation between lipoid-solubility and toxicity of compounds in the DDT group. Rate of solution is probably more important.

Thomas (W. D. E.) & Jones (G. D. G.). **The Systemic Properties of Diethyl-*S*-2-(ethylthioethyl) Phosphorothiolate (Demeton-S) with Reference to the Contamination of Nectar.**—*Ann. appl. Biol.* **43** no. 2 pp. 182–191, 1 graph, 11 refs. London, 1955.

The systemic insecticide Systox normally contains a mixture of the two isomers, diethyl 2-(ethylthio)ethyl phosphorothionate and diethyl S-2-(ethylthio)ethyl phosphorothiolate [*cf. R.A.E.*, A **43** 8, 69 note], for which the common names demeton-O and demeton-S, respectively, have been proposed. Demeton-O is toxic to honey bees [*cf.* **43** 131], and sublethal amounts may possibly be transported in nectar by them and contaminate the honey. Demeton-S has been shown to be about ten times as toxic as demeton-O to mammals [*cf.* **40** 327] and (in unpublished experiments) to insects, and investigations were therefore carried out to ascertain whether it or any derivative of it appears in the nectar of sprayed plants and also its rate of translocation and breakdown in the plant. The demeton-S used was prepared from radioactive phosphorus (^{32}P).

The following is based on the authors' summary of the work. The fate of demeton-S in white mustard (*Brassica alba*), borage (*Borago officinalis*) and field beans (*Vicia faba*) was followed over several weeks by means of the radioactive tracer technique. Radioassay of nectar samples from flowers that opened a few days after spraying showed no unchanged demeton-S, but degradation products were present in small amounts. The highest value for total radioactivity found in the nectar corresponded to 2·7 parts per million expressed as demeton-S.

Radioassay of treated leaves and new growth after spraying confirmed that demeton-S is rapidly converted in the plant into two primary degradation products extractable by chloroform. Further breakdown occurs and is still more rapid in new growth, but appreciable quantities of the two primary degradation products were retained by treated leaves several weeks after spraying. Chrysanthemum cuttings that had absorbed an extract of them proved toxic to *Macrosiphum* (*Macrosiphoniella*) *sanborni* (Gill.). It is concluded that the extent to which demeton-S appears in the nectar is negligible, but that some contamination by degradation products possibly toxic to man occurs.

Lord (K. A.). **Esterase Inhibition by Organo-phosphorus Residues, with some Observations on possible Effects on Plant Metabolism.**—*Ann. appl. Biol.* **43** no. 2 pp. 192–202, 5 graphs, 9 refs. London, 1955.

The following is based on the author's summary. An account is given of investigations in which organo-phosphorus residues in tissues of sprayed plants were detected by estimating the esterase-inhibiting activity of leaf and root extracts from them. The experimental material consisted of mangel plants that had been sprayed with commercial preparations of parathion, bis(dimethylamino)fluorophosphine oxide (here referred to as phosphorofluoridous bisdimethylamide), and Systox (a mixture of O,O-diethyl O-2-(ethylmercapto)ethyl phosphorothioate [demeton-O] and O,O-diethyl S-2-(ethylmercapto)ethyl phosphorothioate (demeton-S)), and bean plants (*Vicia faba*) sprayed with demeton-S [*cf.* preceding abstract]. Extracts of the leaves of the treated mangels were shown to inhibit added cholinesterase from *Blattella germanica* (L.) for some weeks after treatment, and the enzymic hydrolysis of phenyl acetate by extracts of the leaves and roots was reduced for periods ranging up to eight weeks. Analysis of bean plants sprayed with demeton-S showed that anti-esterase activity was limited to those parts that had been sprayed; tissues that developed after spraying had no anti-esterase effect. Leaves sprayed about two months previously inhibited added cholinesterase and showed reduced activity in hydrolysing phenyl acetate. There was some evidence that substances, possibly substrates in the plant enzyme systems affected, accumulate in treated leaves.

Bradbury (F. R.) & Armstrong (G.). **Chemical Structure and narcotic Potency to Grain Weevils. Alcohols and Methyl Esters of Fatty Acids.**—*Ann. appl. Biol.* **43** no. 2 pp. 203–212, 1 graph, 17 refs. London, 1955.

The following is taken from the authors' summary of this account of experiments in which the narcotic potencies of the first seven homologous alcohols and the methyl esters of the first seven homologous fatty acids were determined by the method previously described using *Calandra granaria* (L.) [*R.A.E.*, A **43** 88], and their toxicities ascertained by transferring treated weevils from the flasks to tubes containing a few grains of wheat and noting mortality 72 hours later. The experiments were designed as balanced incomplete blocks, and Finney's probit plane technique was applied to the results. In both series of compounds the narcotic and toxic potencies expressed in thermodynamic concentrations decreased with increasing number of carbon atoms. The margin between narcotic dose and toxic dose is greater in the alcohol series than in the ester series. The methyl esters of the fatty acids showed a stepwise descent in biological potency, the odd numbered series being more active than the even series. The penetration of these compounds into grain weevils and their biological action are discussed in relation to the coefficients of response to log concentration and log time of exposure.

Hewlett (P. S.) & Gostick (K. G.). **The Loss of Weight of Pyrethrin-treated Flour Beetles, *Tribolium castaneum* (Herbst), and its Application to Bioassay.**—*Ann. appl. Biol.* **43** no. 2 pp. 213–236, 3 graphs, 23 refs. London, 1955.

The following is based partly on the authors' summary. It was observed by the senior author in work already noticed [*R.A.E.*, A **37** 231] that adults

of *Tribolium castaneum* (Hbst.) sprayed with pyrethrins in oil lost 5 per cent. or more of their weight in the three hours following spraying, whereas untreated examples lost less than 1 per cent. The weight lost by batches of beetles is a readily determined graded response and was accordingly investigated with a view to its use in bioassay. The beetles were exposed on films formed by solutions of pyrethrins on filter paper, and it was found in a preliminary comparison with other stored-product beetles that the percentage losses in weight (as compared with untreated individuals) under conditions in which *T. castaneum* lost 6·2 per cent. were 6 for *T. confusum* Duv., 1·7 for *Tenebrio molitor* L., 5·2 for *Alphitobius laevigatus* (F.), 2·8 for *Bruchus* (*Acanthoscelides*) *obtectus* Say, 1·4 for *Calandra granaria* (L.), 3·3 for *Dermestes maculatus* Deg., and 2·6 for *Ptinus tectus* Boield., none of these showing therefore any obvious advantage over *Tribolium castaneum* as the test insect.

In investigations on this weight loss, batches of 50–150 adults of *T. castaneum* were confined for some three hours on treated filter papers. Strong evidence was obtained that, in pyrethrum extracts, it is the total pyrethrins alone that cause loss of weight, and that the latter is not modified by the other extractives present. Allethrin also caused a rapid weight loss, and piperonyl butoxide, which by itself caused little loss, greatly increased that caused by pyrethrum solutions and by allethrin, this parallelling its effects on toxicity. The pyrethrin content of solutions appeared to account quantitatively for their weight-reducing activities. Ultra-violet irradiation of pyrethrum films that destroyed their toxicity also destroyed their weight-reducing properties, and neither heating pyrethrum oleoresin to destroy the pyrethrins nor irradiation of pyrethrum extract modified the weight loss caused by allethrin deposited on films of these.

When the beetles were exposed, mostly for three hours at 25°C. [77°F.], on hard filter papers treated with solutions of pyrethrins in a non-volatile oil at a dosage of 19 mg. solution per 10 sq. cm., the curves showing loss in weight rose sigmoidally with increasing pyrethrin concentration from about 0·7 per cent. for zero concentration to an upper (plateau) limit of about 6·5 per cent. of the initial weight of the beetles at a concentration of about 1·5 per cent. pyrethrins. The curve was rendered linear by a transformation involving the use of logits, which are theoretically preferable to probits [**22** 440] in the analysis of graded-response data. Two definitions of logits are current, and that on which Finney based his tables is adopted, namely, that the logit, Y, corresponding to a proportional response, P, is given by the formula $Y = 5 + \frac{1}{2} \log_e (P/Q)$, where $Q = 1 - P$.

Weight loss was influenced by the nature of the carrier oil, and increased with duration of exposure to the pyrethrins and generally with temperature. At 25°C., it was not affected by rate of air movement or by relative humidity between 40 and 90 per cent. The solutions of pyrethrins in oil were satisfactorily applied to the filter papers by means of a spraying tower or by pipette if they were first diluted with a volatile solvent that was subsequently allowed to evaporate. Deposits of given pyrethrum content were about 1–3 times as active in causing weight loss when prepared by spraying as when prepared by solvent evaporation.

Bioassay by weight loss was used in preliminary tests to determine the pyrethrum content of unknown dilutions of a commercial concentrate. The technique of such tests and the mathematical analysis of the results are discussed. The method had about the same inherent precision as the film method of Parkin & Green [**32** 182], but was less precise than the direct spray method of Hewlett [**37** 231]. However, larger numbers of beetles can be used in the new method and the results are obtained more quickly.

In comparative tests with films of other insecticides, DDT, γ BHC, aldrin

and dieldrin also caused loss of weight of *T. castaneum*, but were less rapid in action than pyrethrins.

PUTTARUDRIAH (M.). **The Status of the Mealybug on Sugarcane with special Reference to Mysore State.**—*Indian J. Ent.* **16** pt. 1 pp. 1–10, 32 refs. New Delhi, 1954.

Saccharicoccus sacchari (Ckll.) was a minor pest of sugar-cane in Mysore until 1950, when extremely dry conditions in the principal area concerned made the plants susceptible to injury. Infestation was most severe on the old canes, and continued even on harvested canes, but was slight on canes less than four months old. Dense colonies comprising all stages were observed, situated mainly on the lower 4–5 nodes and enclosed by the partly opened leaf sheaths, and these caused stunting and sometimes the death of the plants. The crawlers moved up the plants and were found under the closely adhering leaf sheaths of the upper nodes. The synonymy of the Coccid, and its distribution, food-plants, morphology, life-history and control are reviewed, mainly from the literature. Sprays of DDT or oil-resin soaps and dusts of DDT, BHC or toxaphene were tested on setts in the laboratory and plants in the field, but gave no control as the insects are protected by the leaf sheaths. Some control was afforded by predators, including the Drosophilid, *Gitonides perspicax* Knab, and the Coccinellids, *Pharoscymnus grimeti* Muls.* and *Scymnus* (*Pullus*) sp., and by an Encyrtid parasite, *Anagyrus saccharicola* Timb.

REDDY (D. B.). **Environmental Factors affecting the Mortality of Adults of the Rice Weevil.**—*Indian J. Ent.* **16** pt. 1 pp. 14–19, 3 refs. New Delhi, 1954.

The factors that affect the development of populations of *Calandra* (*Sitophilus*) *oryzae* (L.) in stored grain include air temperature and humidity and the moisture content of the grain, and the effect of these on the adults and the relative susceptibility of the males and females to them were investigated. Weevils were exposed in jars to temperatures ranging from 20 to 35°C. [68–95°F.] at relative humidities of 30 and 73 per cent. and to relative humidities of 52 and 84 per cent. at 35°C., some in each series being provided with rice or wheat of various moisture contents as food and others not; the moisture content of the wheat in each sample was determined at the beginning and end of the experiment.

At 30 per cent. relative humidity, the period of survival was longest at 20°C. and decreased steadily as the temperature rose. It was little affected by the presence of wheat of 7·1 per cent. initial moisture content, but was extended when the moisture content was 13–13·5 per cent., except at temperatures of 32°C. [89·6°F.] or more, at which food appeared to have little effect. At 73 per cent. relative humidity, mortality was still incomplete after 186 hours in the presence of wheat of 7 or 12·1 per cent. initial moisture content, but increased from 4 per cent. at 20°C. to 64 and 40 per cent., respectively, at 35°C. In the absence of food, mortality was complete in 186 hours at 20° and in 66 hours at 35°C., showing a steady decrease in survival time between the two temperatures. At 30 per cent. relative humidity, the moisture contents of the wheat fell during the tests, the higher one more rapidly than the lower, whereas at 73 per cent., they

* We are informed by Mr. R. D. Pope, who identified this Coccinellid for the author, that he has since found that "*Pharoscymnus grimeti* Muls." is a *nom. in coll.*, and that the correct name for the species is *P. horni* Weise.—Ed.

increased, the lower more rapidly than the higher. Both changes were greater at high than at low temperatures, and the results indicated that the weevil could be controlled even in grain of high initial moisture content by storing at high temperature and low humidity, which would reduce the moisture content and make it unsuitable for the weevil.

At 35°C. and 52 per cent. relative humidity, mortality of males and females was complete in 248 and 296 hours, respectively, in the presence of rice and in 162 and 222 hours in its absence. At 35°C. and 84 per cent. relative humidity, only 14 and 8 per cent., respectively, of the males and females died in 296 hours in the presence of rice, whereas all were dead in 248 and 296 hours when no food was provided.

Gupta (R. L.). **Life-history of** *Tonica zizyphi* **Stn.—the Citrus Leaf Roller.** —*Indian J. Ent.* **16** pt. 1 pp. 20–23, 5 refs. New Delhi, 1954.

Larvae of *Psorosticha* (*Tonica*) *zizyphi* (Stnt.) sometimes cause serious injury to *Citrus* seedlings in Madhya Pradesh, where they are common during the wet months of July–September and then decrease in numbers, disappearing during the hot weather of May–June. The eggs of this Gelechiid are laid singly or in groups along the midribs of the leaves, and the larvae fold and web the leaves and feed at first on the epidermis and later on the tissues of all layers. Pupation occurs within the folded leaf [*cf. R.A.E.*, A **23** 50]. In the laboratory, the adults lived for 5–16 days when sugar solution was provided and for 2–6 days without it, and the preoviposition, oviposition and postoviposition periods lasted 1–4, 3–11 and 1–10 days, respectively. Ten females laid 92–404 eggs each, and the egg, larval and pupal stages and the life-cycle from egg to adult lasted 3–5, 11–19, 5–10 and 20–31 days, respectively. *Apanteles* sp., *Pristomerus* sp. and *Brachymeria cuploeae* (Westw.) emerged from larvae collected in the field. Sprays of DDT, crude-oil emulsion, nicotine sulphate, alone and with fish-oil resin soap, and fish-oil resin soap alone gave significant control in tests, the last, at 1 oz. per gal. water, being the best.

Khan (Nawab H.). **Ecological Observations on the Eggs of** *Gryllodes sigillatus* **(Walker).**—*Indian J. Ent.* **16** pt. 1 pp. 24–26, 1 graph, 1 ref. New Delhi, 1954.

Gryllodes sigillatus (Wlk.) is a common household pest in India and causes considerable damage to textiles. The eggs are usually laid 0·4–0·6 inch deep in soft earth, but are sometimes deposited under damp paper or in food. The duration of the egg stage depends largely on temperature and humidity. In the laboratory, eggs kept at mean temperatures of 33·9, 32·6 and 32·2°C. [93·02, 90·68 and 89·96°F.] and 70·9, 77·6 and 78 per cent. relative humidity, respectively, hatched in 6–11, 7–11 and 7–17 days, and five newly emerged females confined separately with males in jars containing loose earth and food laid an average of 170·2 eggs in 2–19 days, after preoviposition periods of 3–9 days. When batches of 300 eggs were kept at constant temperatures and humidities for 44 days, the percentages that hatched were 10, 17 and 0 at 20°C. [68°F.] and 35, 81 and 93·1 per cent. relative humidity, respectively, 12·33, 34·33 and 0 at 25°C. [77°F.] and 43, 81·1 and 93 per cent. relative humidity, and 8·6, 8·33 and 4·3 at 30°C. [86°F.] and 68·6, 81·1 and 92·9 per cent. relative humidity, from which it is concluded that humidities above 92 per cent. are unfavourable and that the optimum conditions for egg development are 20–25°C. and 80–82 per cent. relative humidity.

Agarwala (S. B. D.) & Sharma (C.). **Aldrin and Dieldrin as outstanding Agents in the Control of** *Microtermes obesi* **Holmgr. on Maize in Bihar.** —*Indian J. Ent.* **16** pt. 1 pp. 78–79, 4 refs. New Delhi, 1954.

Maize is often seriously damaged by *Microtermes obesi* Hlmgr. in Bihar, and experiments were therefore carried out on the effectiveness of aldrin, dieldrin, BHC (13 per cent. γ isomer) and toxaphene (chlorinated camphene), applied at 0·2, 0·25, 0·35 and 3 lb. actual toxicant per acre, respectively, in protecting it from this termite. Dusts were mixed into the top six inches of soil with a spade not more than 24 hours before sowing, and the treatments were evaluated by observations on germination, mortality of plants and yield. The treatments did not significantly improve germination, but aldrin and dieldrin caused significant reduction in the mortality of plants due to termite injury during the first eleven weeks of growth. They apparently provided no further protection, but they increased the yield significantly. The other treatments had no significant effect.

Singh (M. P.). **A Note on the Incidence of Caterpillars of** *Estigmene* (*Amsacta*) *lactinea* **in the " Diara " Lands of Shahabad Dt. (Bihar).** —*Indian J. Ent.* **16** pt. 1 pp. 80–82. New Delhi, 1954.

In Bihar, the former beds of rivers that have changed their course (diara lands) are usually very fertile and covered with abundant vegetation but are subject to annual flooding. In 1947, when the rains were heavy and early, larvae of *Amsacta* (*Estigmene*) *lactinea* (Cram.) were numerous and very injurious to rice seedlings in areas of this nature in Shahabad district, and in 1948 they attacked maize. They were not observed until the beginning of the monsoon, when weeds became abundant. Adults, egg-masses and young larvae were numerous on these, particularly on *Crotalaria saltiana* (*striata*), and migration to fields of maize was observed. In 1949, weeds were cut as a control measure, and the damage by the Arctiid was reduced from 25–35 to 5–6 per cent. No reports of injury were received in 1950–52.

Majumdar (S. K.) & Pingale (S. V.). **A simple Method for detecting the Presence of Residues of Chlorinated Insecticides.**—*Indian J. Ent.* **16** pt. 1 pp. 82–83, 2 refs. New Delhi, 1954.

In view of the injurious nature of chlorinated-hydrocarbon residues, the authors describe a simple method of determining their presence on food crops, by which a large number of samples can be examined rapidly. The samples are washed with acetone, and the washings are filtered through cotton-wool and concentrated to about 1 ml. A drop of the concentrate is put on white filter paper and allowed to dry, after which it is covered and surrounded with chlorine-free monoethanolamine and heated at 90–100°C. for an hour. The paper is then sprayed with a mixture of concentrated nitric acid and 0·01 N silver nitrate in distilled water (1:3) and exposed to sunlight, when a conspicuous violet colour develops in 5–7 minutes if a chlorinated hydrocarbon is present. Residues of DDT, BHC, aldrin and dieldrin on potatoes and BHC on wheat were detected by this method.

Lower (H. F.). **A granulosis Virus attacking the Larvae of** *Persectania ewingii* **Westw. (Lepidoptera: Agrotidae) in South Australia.**—*Aust. J. biol. Sci.* **7** no. 2 pp. 161–167, 1 pl., 1 fig., 2 refs. Melbourne, 1954.

During studies on *Persectania ewingii* (Westw.) in South Australia, a dense isolated population of larvae heavily infected with a granulosis virus was

discovered in tussock grassland in which *Stipa pubescens* predominated near Adelaide. Most of the current year's growth had been destroyed. In laboratory investigations, symptoms did not become apparent until the larvae reached the fifth or sixth instar, and a few of those in which this appearance was delayed were able to complete their development. Infected larvae ceased to feed and suspended themselves head downwards on grass stalks, the cuticle became translucent and dull grey in colour, and the body contents liquefied from the anal end, so that the anterior end became distended and eventually disrupted, permitting the escape of a dark brown, odourless fluid. The fat-body in newly suspended larvae was found to be greatly enlarged and the fatty material replaced by a suspension containing numerous granules enclosing virus rods. Of 5,000 field-collected larvae, comprising 4,973 in the fifth and sixth instars with visible symptoms and 27 in the fourth instar that developed symptoms later, 4,803 died and 195 attempted to pupate below litter on the surface of the soil without constructing a pupal cell within it. A total of 51 adults of *P. ewingii* and 144 parasite adults, comprising 11 Braconids and 133 Tachinids of four species, eventually emerged. In tests on transmission, healthy larvae in any instar became infected if placed in a cage that contained or had recently contained diseased larvae. Healthy larvae also became infected by ingesting food contaminated by saliva or frass from diseased larvae, and tests with a needle indicated that ovipositing Hymenopterous parasites may be of importance in transmitting the disease from one population to another. The origin of the observed epizootic is unknown, but factors contributing to the rapid spread and high mortality were the density of the larval population, the larval habit of congregating at the base of grasses from which the body fluids of dead larvae were washed down by rain and dew, and the absence of food other than the contaminated grass. In addition, the scarcity of food had probably lowered the resistance of the larvae, and the weather was abnormally wet and cloudy, so that they were exposed to a mild, humid atmosphere.

Wallace (M. M. H.). **Experiments on the Control of the Lucerne Flea (*Sminthurus viridis* (L.)) and the Red-legged Earth Mite (*Halotydeus destructor* (Tuck.)) in Pastures in Western Australia.**—*Aust. J. agric. Res.* **5** no. 2 pp. 317–326, 2 pls., 13 refs. Melbourne, 1954.

The following is based partly on the author's summary. *Halotydeus destructor* (Tucker) is readily controlled by DDT and, to a less extent, BHC [*cf. R.A.E.*, A **35** 158; **36** 309], but no satisfactory insecticide was available against *Sminthurus viridis* (L.) [*cf.* **37** 102; **43** 78], and tests with BHC, which had shown promise against it in earlier experiments, chlordane, and parathion were accordingly carried out against both species in Western Australia. The insecticides were applied by means of a low-volume boom sprayer in 5 gals. spray per acre to a mixed pasture of *Hordeum* sp., *Medicago* sp. and *Erodium* spp. on 19–20th June 1952. A spray of 2 lb. 50 per cent. dispersible BHC powder per acre had no effect on *S. viridis* but gave about 90 per cent. mortality of *Halotydeus*. Chlordane at 0·5 lb. per acre was useless against either pest. A 20 per cent. parathion emulsion concentrate at $\frac{1}{4}$ pint per acre gave almost complete kill of *S. viridis* in ten days but the toxicity of the residue was negligible and individuals that hatched from eggs present at the time of spraying were unharmed. The population had increased considerably 25 days after treatment, and an application of parathion at half the previous concentration combined with 1 pint 20 per cent. p,p′DDT per acre was made on 4th August. This gave good immediate control of *S. viridis* and complete control of *H. destructor*,

which had been little affected by the first parathion spray, but it appeared to be toxic to predacious Bdellid mites [*cf.* **43** 78], of which the principal species present was *Bdella* (*Scirus*) *longirostris* (Hermann).

It is concluded that parathion is highly effective against *S. viridis*. In view of its lack of ovicidal or persistent effect and in order to obtain the maximum benefit, it should be applied 3–6 weeks after the beginning of the autumn rains, when eggs that have been in diapause during summer have hatched but adults have not yet appeared. In the experiments described, a single application, made too late for maximum effect, gave some protection for almost the whole season. In a discussion of the possible hazards to stock, it is pointed out that parathion residues disappear rapidly, so that the risk of ingestion of harmful amounts of parathion is extremely slight. No harmful effects on the growth of the pasture were observed.

Cumber (R. A.). **Search for alternative Vectors of the Yellow-leaf Disease of** *Phormium*.—*N.Z. J. Sci. Tech.* **36** (A) no. 1 pp. 32–37, 4 refs. Wellington, N.Z., 1954. **Injury to** *Phormium* **caused by Insects, Mites and Molluscs.**—*T.c.* pp. 60–74, 20 figs., 23 refs.

An account is given in the first of these papers of experiments carried out in New Zealand to determine whether the yellow-leaf disease of *Phormium tenax* is transmitted by vectors other than *Oliarus atkinsoni* Myers [*cf. R.A.E.*, A **43** 347]. Five species of Hemiptera that feed on or are associated with the plant were tested, and completely negative results were obtained with all but *Trionymus diminutus* (Leon.), which is common on *Phormium*. No conclusions are drawn, however, since some of the control plants also developed symptoms.

The second paper comprises very brief notes on the damage caused to *Phormium* in New Zealand by various pests and on their bionomics and importance.

Palmer-Jones (T.), Bartrum (F. A.), Forster (I. W.) & Harrison (D. L.). **Effect on Honey Bees of DDT plus Superphosphate applied as a Dust to White Clover Pasture.**—*N.Z. J. Sci. Tech.* **36** (A) no. 2 pp. 177–192, 8 figs., 16 refs. Wellington, N.Z., 1954.

The following is based on the authors' summary. DDT in superphosphate was applied to 12 acres of pasture consisting mainly of white clover (*Trifolium repens*) in New Zealand at a rate of 2 lb. p,p′DDT per acre as recommended for the control of *Costelytra zealandica* (White) and *Oxycanus* spp. [*cf. R.A.E.*, A **40** 206]. Honey bees were collecting nectar extensively from the experimental area, and very definite evidence was obtained that the DDT repelled the bees for some days after application. Bees collected from the dusted clover flowers did not show high mortality and no adverse effects on the colonies were observed. It is concluded that such treatments cause negligible mortality among bees.

Cohic (F.). **Enquête phytosanitaire sur les plantations des Nouvelles-Hébrides.**—*Rev. agric. Nouv. Calédonie* (N.S.) **4** no. 1–6 pp. 11–21. Nouméa, 1953.

Notes are given on the insects and fungi observed attacking various crops during a short visit to the New Hebrides, together with a brief description of the climate and agricultural conditions of the islands. The most harmful

of the insects found on coconut [*cf. R.A.E.*, A **23** 548] were *Brontispa longissima* (Gestro) (*froggatti* Sharp), which injures the leaves, especially in young plantations and in dry areas; *Diocalandra taitensis* (Guér.), which destroys the roots above the soil and the bases of the leaves but is of less importance than is commonly thought as the yield is not appreciably affected; *Rhabdoscelus obscurus* (Boisd.), which has apparently not so far been recorded from the New Hebrides, and though considered elsewhere to attack only palms that are already diseased, was found mining in the stem at the base of the clusters on healthy trees, causing the clusters to fall; a Platypodid, probably undescribed, of which the adults mined in the bark; *Tirathaba* sp., the larvae of which attack both male and female inflorescences and bore into the young fruits, particularly in young groves; *Batrachedra arenosella* (Wlk.), of which the eggs are laid on the unopened spathes and the larvae destroy the male and sometimes the female inflorescences within; termites, which are particularly injurious, killing palms in damp groves and those invaded by undergrowth or interplanted with coffee or cacao; *Scholastes* sp., the larvae of which enter ripe nuts lying on the ground; and the Phasmid, *Graeffea crouanii* (Le Guillou) (*cocophaga* (Newp.)), which was very injurious to the leaves on Espiritu Santo Island. *Promecotheca opacicollis* Gestro, which was formerly a serious pest of coconuts in the New Hebrides [*cf.* **7** 458; **23** 547], has been completely controlled by the introduced parasite, *Pleurotropis parvulus* Ferrière [*cf.* **27** 366], and could not be found.

The most important of the insects attacking cacao were the Lamiids, *Pterolophia* (*Praonetha*) *binodosa* (Bates), the larvae of which mine in the trunks of young trees and in the branches of older ones, causing them to dry up, and *Monochamus* (*Monohammus*) *holotephrus* (Boisd.), which is the more injurious, boring in the trunks of large trees; *Pseudococcus* sp., which infests the peduncles and causes severe loss of pods; and termites, which attack the trees at the site of a wound and rapidly destroy them.

Other pests observed included *Pseudococcus* sp. on coffee, *Cosmopolites sordidus* (Germ.) and the scab moth, *Nacoleia* (*Lamprosema*) *octasema* (Meyr.), on banana, *Cnemidothrix protensus* Fairm. on orange and cacao, and the fruit-piercing moth, *Eumaenas* (*Maenas*) *salaminia* (Cram.), on orange and banana. In addition, it is stated that on Efate Island, *E. salaminia* and another fruit-piercing moth, *Othreis fullonia* (Cl.) (*Ophideres fullonica* (L.)) were observed attacking *Citrus*, *Achaea janata* (L.) was found on castor (*Ricinus communis*) and *Margaronia* (*Diaphania*) *indica* (Saund.) on cucurbits, and that during a brief visit to Aneytum, in the south of the group, *Aulacophora similis* (Ol.) [*cf.* **36** 390, etc.] and *Leptoglossus australis* (F.) were observed on cucurbits, *Mictis profana* F., *Unaspis* (*Chionaspis*) *citri* (Comst.), and *Ceroplastes rubens* Mask. on *Citrus*, and *Agonoxena argaula* Meyr., *Pseudococcus* sp. and *Diaspis* sp. on coconut, the last being particularly abundant on young palms near the sea.

Kamal (A. S.). **Ecological and nutritional Studies on the Cherry Fruit Fly.** —*J. econ. Ent.* **47** no. 6 pp. 959–965, 4 graphs, 6 refs. Menasha, Wis., 1954.

The following is based largely on the author's summary of this account of investigations in 1952–53 in which newly emerged adults of *Rhagoletis cingulata* (Lw.) were maintained at constant temperatures of 65–90°F. in cages containing sugar and cherries, which were removed daily and kept at 77°F. for observations on the eggs and larvae. Mating, flight and other adult activities were normal. Feeding punctures were found 2–3 days before the first egg, eggs were deposited singly under the skin of the

cherries, and an average of 17 days was required for the egg and larval stages together. Pairing activity, the percentage of females that produced eggs, the number of eggs produced and the daily rate of oviposition were greatest at 80°F. The oviposition period increased in duration from 13 to 36 days as the temperature rose from 65 to 80°F., but dropped suddenly to one day at 90°. The preoviposition period was 7–12 days. It decreased and egg-production increased as the temperature rose. The supply of yeast increased fecundity and shortened the life span, whereas a low light intensity increased both.

In pre-season tests with adults that emerged from pupae kept at 32–40°F. for five months, only females kept at 80°F. deposited eggs, though those kept at 70° contained as many; temperatures of 60 and 90°F. both retarded egg development in the flies.

Atkins jr. (E. L.), Anderson (L. D.) & Tuft (T. O.). **Equipment and Technique used in Laboratory Evaluation of Pesticide Dusts in toxicological Studies with Honeybees.**—*J. econ. Ent.* **47** no. 6 pp. 965–969, 5 refs., 6 refs. Menasha, Wis., 1954.

The following is substantially the authors' summary. Photographs and descriptions are given of the bell-jar vacuum duster, holding cages, dusting cages, stock bee cages, aspirating apparatus and other equipment used in the laboratory evaluation of the toxicity of insecticidal dusts to honey bees [*cf.* next abstract]. The technique of using the equipment is described in detail, together with the precautions employed to avoid contamination.

Atkins jr. (E. L.) & Anderson (L. D.). **Toxicity of Pesticide Dusts to Honeybees.**—*J. econ. Ent.* **47** no. 6 pp. 969–972, 5 refs. Menasha, Wis., 1954.

The following is substantially the authors' summary. The results are given of laboratory tests to determine the relative toxicity of 55 dusts, mainly insecticides, to honey bees. Pyrophyllite was used as the diluent, and all materials were applied by means of a bell-jar vacuum duster [*cf.* preceding abstract]. Materials that proved highly toxic to the bees comprised dinoseb, EPN [ethyl p-nitrophenyl thionobenzenephosphonate], sabadilla, lindane [almost pure γ BHC], BHC, heptachlor, chlorthion [O,O-dimethyl O-3-chloro-4-nitrophenyl thiophosphate), Metacide [methyl-parathion and parathion), aldrin, dieldrin, Diazinon [O,O-diethyl O-2-isopropyl-4-methyl-6-pyrimidinyl thiophosphate], malathion, methyl-parathion, parathion, TEPP [tetraethyl pyrophosphate], Compound A-42 (arsenomethane As-1,2-disulphide), Compound 340 (1-isopropyl-3-methyl-5-pyrazolyl dimethylcarbamate), endrin and chlordane. Moderately toxic materials were Potasan [O,O-diethyl O-4-methyl-7-coumarinyl thiophosphate], Compound 21/116 [O,O-dimethyl O-2-(ethylmercapto)ethyl thiophosphate], Q-137 [1,1-bis(p-ethylphenyl)-2,2-dichloroethane (ethyl-DDD)], DDT, calcium arsenate, isodrin, Compound 1189 [2,3,3a,4,5,6,7,7a,8,8-decachloro-3a,4,7,7a-tetrahydro-4,7-methanoindene-1-one], tartar emetic, Chlorobenzilate [ethyl 4,4′-dichlorobenzilate], Compound 21/199 [O,O-diethyl O-3-chloro-4-methyl-7-coumarinyl thiophosphate], cryolite, Compound 876 (bis(p-chlorophenyl)-ethynyl-carbinol), ryania, NPD (tetra-n-propyl dithionopyrophosphate), DDD (TDE), R-242 [p-chlorophenyl phenyl sulphone], schradan, methoxy-DDT (methoxychlor), dinex, Aramite [2-chloroethyl 2-(p-tert.-butylphenoxy)-1-methylethyl sulphite] and toxaphene. Relatively safe materials were sulphur, rotenone, Ovotran [p-chlorophenyl p-chlorobenzenesulphonate], chlorinated terpine,

Q-128 (ethyl-DDT [1,1-bis(p-ethylphenyl)-2,2,2-trichloroethane]), pyrethrins, Compound 923 [2,4-dichlorophenyl benzenesulphonate], Neotran [di(p-chlorophenoxy)methane], CMU (3-(p-chlorophenyl)-1,1-dimethyl urea), demeton [diethyl 2-(ethylmercapto)ethyl thiophosphate], allethrin, DMC [1,1-bis(p-chlorophenyl)ethanol], Cunilate (copper 8-hydroxyquinolinate), CS-708 [a 1:2 mixture of 1,1-bis(p-chlorophenyl)-2-nitropropane and 1,1-bis(p-chlorophenyl)-2-nitrobutane] and nicotine.

Ivy (E. E.) & Scales (A. L.). **Are Cotton Insects becoming resistant to Insecticides ?**—*J. econ. Ent.* **47** no. 6 pp. 981–984, 6 refs. Menasha, Wis., 1954.

In view of recent reports of the failure of organic chemicals to control various pests, notably *Alabama argillacea* (Hb.) and Tetranychid mites, on cotton in the United States, the authors review results obtained since 1946 in laboratory tests in Texas. In tests of dusts against *A. argillacea*, toxaphene showed median lethal doses of 0·17 lb. per acre in 1946, 0·79 lb. in 1952 and 1·62 and 1·82 lb. in 1953, when the test insects originated from treated and untreated fields, respectively, and almost complete control could still be obtained with 10 lb. calcium arsenate or 0·1 lb. parathion per acre. It is difficult to see how this species could become resistant to toxaphene in the United States, since the population dies out each year, and it seems likely that resistance has arisen in Central or South America, where the moths that migrate to the United States develop.

In 1952, a laboratory strain of *Tetranychus tumidus* Banks proved more difficult to control than before with parathion and other phosphorus compounds, possibly because of resistance induced by accidental contamination of the laboratory with volatile phosphorus compounds, and comparison of these mites with a greenhouse strain in January showed that 0·008 and 0·006 lb. parathion per acre, respectively, gave 50 per cent. kill and 0·121 and 0·022 lb. 90 per cent. Half of each strain was then treated three times in the course of a few generations with a dosage giving approximately 99 per cent. kill and compared with the original strains in April, when the doses for 50 per cent. kill of the untreated and treated greenhouse strain and the untreated and treated laboratory strain were 0·014, 0·167, 0·038 and 0·102 lb. per acre and those for 90 per cent. kill were 0·036, 0·462, 0·116 and 0·513 lb. When the treated cultures were subjected to a further three treatments, resistance did not increase, but in September, when the final tests were made, it was found that the untreated cultures had unexpectedly become much harder to kill.

No resistance to insecticides was encountered in *Aphis gossypii* Glov., and a culture of this Aphid reported to be resistant to BHC in South Carolina was found to be slightly easier to kill with γ BHC than the local strain. No resistance had developed in *Anthonomus grandis* Boh. or *Heliothis armigera* (Hb.). The former was apparently as susceptible to BHC and toxaphene and the latter to DDT and toxaphene as when these insecticides were first used against them.

Dills (L. E.) & Odland (M. L.). **Insecticide Tests with Cabbage Caterpillars and Aphids.**—*J. econ. Ent.* **47** no. 6 pp. 992–995, 8 refs. Menasha, Wis., 1954.

In tests against cabbage pests in Pennsylvania, dusts were applied in the field to give equal weights of toxicant per acre. In 1951, when *Plutella maculipennis* (Curt.) was present, but *Trichoplusia ni* (Hb.) and *Pieris*

rapae (L.) caused most of the damage and hot dry weather favoured the development of *Brevicoryne brassicae* (L.), DDT was applied at 0·5–2 per cent., DDD and dieldrin at 0·5 and 1 per cent., ethyl-DDD (1,1-bis(p-ethylphenyl)-2,2-dichloroethane) and methoxy-DDT (methoxychlor) at 1 and 2 per cent., lindane [almost pure γ BHC] and chlordane at 1 per cent. and allethrin and ryania at 0·23 and 15 per cent., respectively. In 1952, the cabbages were set late and infestation was low; *T. ni* was the most injurious of the insects, *P. rapae* and *Plutella* caused some damage and infestation by the Aphid was light. DDT, DDD and dieldrin at 0·25 and 0·5 per cent. and a mixture of 0·5 per cent. dieldrin and 1 per cent. lindane were tested. In 1953, considerable feeding occurred before the insecticides were applied; *T. ni* was much more abundant than *Picris*, and Aphid damage was negligible. Isodrin, DDD, DDT, dieldrin and heptachlor were tested at 0·25–1 per cent.

DDD resulted in less damage by the Lepidoptera than any other material that was tested in more than one year. It was significantly superior to DDT in 1951 and 1953 and to dieldrin in 1953. Dieldrin was approximately equal to DDT, and isodrin to DDD; heptachlor appeared to be less toxic than isodrin, DDT, DDD or dieldrin. Ryania with 0·5 per cent. n-propyl isome as a synergist was moderately toxic, as also was lindane; ethyl-DDD was inferior to these but superior to methoxy-DDT. Allethrin with 0·2 per cent. N-(2-ethylhexyl)bicyclo[2.2.1]-5-heptene-2,3-dicarboximide as a synergist proved unsatisfactory, and chlordane was inferior to all the other chlorinated compounds but methoxy-DDT. In 1951, lindane was very effective against the Aphid, and allethrin and 1 per cent. dieldrin were the only other materials that gave significant reductions in numbers. As much of the damage due to insects was caused by the Aphid, the plots dusted with lindane gave much the highest yields. In 1952, the mixture of dieldrin with lindane was the only treatment that significantly reduced Aphid infestation.

Anderson (L. D.). **The Tomato Russet Mite in the United States.**— *J. econ. Ent.* **47** no. 6 pp. 1001–1005, 2 figs., 11 refs. Menasha, Wis., 1954.

The author describes all stages of *Vasates lycopersici* (Massee), of which H. H. Keifer agrees that *V. destructor* (Keif.) is a synonym [*cf. R.A.E.*, A **41** 31], and shows that this Eriophyid, which became an important pest of tomato in California after 1940 [*cf.* **42** 19], had been observed over much of the United States by 1953. Spread was rapid, but the mite can apparently overwinter only in the south of the country, where suitable food-plants are available throughout the year. It appears to be established in many southern areas and to be carried north each year on planting material, though a few infestations in the north probably originate from populations overwintering in greenhouses. It also attacks other solanaceous plants, the main alternative to tomato in California possibly being *Petunia* [*cf.* **32** 199]. The mites complete their development in a week or less and feed externally on the stems and leaves, causing a russetted appearance and resulting in leaf drop and scorching of the fruits; only the severest infestations cause russetting of the latter. The mites are spread rapidly at picking time; they may be carried by wind, but this does not cause rapid spread within a field. Their natural enemies include species of *Typhlodromus* and *Leptothrips mali* (Fitch).

Sulphur dusts give good control of *V. lycopersici* if the plants are thoroughly covered. They should be applied at the rate of at least 10 lb. per acre, and a second application may be necessary after 3–4 weeks. Cultural control is not practicable if wild food-plants are available through

the winter, but the destruction of infested plants in greenhouses and other protected places may be effective in northern areas. In preliminary field tests, toxaphene and parathion gave good control and malathion showed promise when used at adequate dosages and intervals [*cf.* **42** 19–20].

Lange (W. H.), Akesson (N. B.) & Carlson (E. C.). **A Power-driven self-propelled Soil Sifter for subterranean Insects.**—*J. econ. Ent.* **47** no. 6 pp. 1006–1009, 1 fig., 9 refs. Menasha, Wis., 1954.

Details are given of the construction and use of a mobile soil-sifting machine designed to give rapid and accurate counts of wireworms in soil. It is fitted with sifting trays of varying mesh that can be quickly interchanged, and it can be easily moved from place to place with a minimum of soil compaction or loaded on a truck. It has a capacity of 0·25–0·5 cu. ft. soil, can be kept operating almost continuously by two men, and could probably be easily adapted for use with other soil insects. Good comparative counts following many soil treatments were made.

Burrage (R. H.) & Gyrisco (G. G.). **Distribution of Third Instar Larvae of the European Chafer and the Efficiency of various Sampling Units for estimating their Populations.**—*J. econ. Ent.* **47** no. 6 pp. 1009–1014, 3 figs., 5 refs. Menasha, Wis., 1954.

Investigations on the distribution of third-instar larvae of the European chafer [*Amphimallon majalis* (Razoum.)] in the soil [*cf. R.A.E.*, A **43** 315] were made in New York in April–May 1951, when plots of permanent pasture 25 ft. square were divided into units 1 ft. square and these were dug to a depth of 1 ft. and the soil examined. It was found that the larvae were not distributed at random but tended to occur in groups, in a distribution that more closely approached a negative binomial series than a Poisson series. Comparison of the area that it was necessary to sample with units of 1, 4 and 9 sq. ft. to give population estimates of the same precision showed that the first was about 1·8–2·5 and 2·7–4 times as effective as the second and third, respectively, and the second about 1·5 times as effective as the third.

Chiang (H. C.), Cutkomp (L. K.) & Hodson (A. C.). **The Effects of the Second Generation European Corn Borer on Field Corn.**—*J. econ. Ent.* **47** no. 6 pp. 1015–1020, 2 graphs, 5 refs. Menasha, Wis., 1954.

Since the method of estimating the loss in yield of maize due to the European corn borer [*Pyrausta nubilalis* (Hb.)] as 3 per cent. per larva per plant was developed for use in areas in the United States in which there is only one generation a year [*cf. R.A.E.*, A **31** 254] and is not always valid where there are two [*cf.* **40** 242], investigations were carried out in Minnesota in 1952 to determine the effect of the second-generation larvae on yield, stem breakage and ear drop of field maize, and the method of estimating losses is discussed in the light of the results.

The following is taken from the authors' summary. Records were made of the numbers of egg-masses and larvae, the amount of stalk breakage and ear dropping and the yield in two plantings, in which larvae of the first generation were very scarce and those of the second much more numerous. In one, the egg-mass counts for the second generation were very close to the critical level at which insecticide treatment is recommended, and the larval population in some plots in it was reduced by 83 per cent. by two DDT emulsion

sprays applied a week apart in September. The yield did not differ significantly in the sprayed and unsprayed plots, indicating that the current method of estimating yield loss by counting larvae of either generation would give an overestimate. Comparison of the amount of stalk breakage and ear dropping with the numbers of egg-masses and overwintering larvae of both generations showed that they were less well correlated with the number of second-generation egg-masses than with the number of overwintering larvae of this generation, so that insecticidal treatment against the second generation to reduce stalk breakage and ear dropping cannot be reliably based on the number of egg-masses.

The results indicated that the second-generation larvae have little effect on ear growth, but are responsible for stalk breakage and ear dropping. Since the effect of these on yield is indirect and indefinite, depending on whether hand-gleaning follows mechanical picking, there is little basis for assigning the same damage index to the two generations. It is concluded that the two should be distinguished and their effects on the loss in yield assessed separately, although the distinction may be difficult to make in a large-scale survey.

LANCHESTER (H. P.). **Summer Control of Pear Leaf Blister Mite.**—*J. econ. Ent.* **47** no. 6 pp. 1020–1021. Menasha, Wis., 1954.

Eriophyes pyri (Pgst.) is normally controlled on pear by dormant sprays, but may reduce growth or cause fruit injury if these are omitted or badly applied. It cannot be reached by conventional sprays during the growing season owing to the protection afforded by the leaf-blisters. Since materials with systemic action might be effective, the lower branches of pear trees in the Yakima Valley of Washington were sprayed with 0·5, 1 or 2 U.S. pints Systox containing 42 per cent. demeton [diethyl 2-(ethylmercapto)ethyl thiophosphate] or with 1 lb. 15 per cent. wettable parathion per 100 U.S. gals. in August 1952. Examination of blisters on leaves on the unsprayed and sprayed branches in September showed that the mortality percentages were 3 and 26, 12 and 51, and 22 and 37 for the three concentrations of demeton, respectively, and 0 and 4 for parathion, as compared with 0 for no treatment.

In January 1953 the mites were congregated between the scales of the fruit buds on both untreated trees and trees treated with 1 pint Systox emulsion in average numbers of 575 and 2 per bud, respectively. Sprays of 1 pint 50 per cent. demeton per 100 gals. applied to infested trees in early spring increased the proportion of buds without mites, and applications of 2 pints 21 per cent. demeton, 2 lb. 25 per cent. parathion or 4 U.S. gals. lime-sulphur per 100 U.S. gals. in various orchards in autumn reduced the numbers of mites per bud from 3–171·8 to 0–0·5, 0·3–3·9 and 3·2, respectively, and increased the percentage of buds free from mites from 4–38 to 77–100, 42–78 and 79. Few dead individuals were found in buds treated with parathion or lime-sulphur, and these materials may have killed the mites during migration from the blisters to the buds. Predacious mites were found in buds from untreated trees but not in those sprayed with demeton. On some trees sprayed in April, large numbers of *E. pyri* developed in late summer from the extremely sparse population left in some leaves, while there were none in others, and this resulted in even greater variation in bud populations than occurred on untreated trees.

It is concluded that demeton reaches the mites within the leaf and probably within the bud in lethal amounts, and that this or a similar systemic toxicant might well be used on young non-bearing trees or on trees from which the fruit has been harvested.

Lowry (W. L.), Chapman (A. J.), Wratten (F. T.) & Hollingsworth (J. P.). **Tests of the Dielectric Treatment of Cotton Seed for destroying Pink Bollworms.**—*J. econ. Ent.* **47** no. 6 pp. 1022–1023, 2 refs. Menasha, Wis., 1954.

The authors describe preliminary experiments in which cottonseed infested with larvae of *Platyedra* (*Pectinophora*) *gossypiella* (Saund.) was exposed in plastic boxes between the plates of a dielectric heating apparatus. Complete kill was effected at final temperatures of 161–173°F., produced by exposure to 1,300, 1,430, 1,570 and 1,780 volts per inch for 29, 19, 16 and 14 seconds, respectively. Slightly shorter exposures to these gradients resulted in some survival, which increased as the exposure time decreased, and there was also some survival at temperatures of 166–174°F. produced by exposure to voltage gradients of 2,180, 2,300 and 2,400 for 12, 10 and 8·5 seconds, respectively. The effect was produced solely by heat. The treatment did not appear to affect germination or the chemical composition of the seed, but there was some danger of fire at such high voltage gradients.

Shands (W. A.), Simpson (G. W.) & Reed (L. B.). **Subunits of Sample for estimating Aphid Abundance on Potatoes.**—*J. econ. Ent.* **47** no. 6 pp. 1024–1027, 12 refs. Menasha, Wis., 1954.

The senior authors have developed a method of sampling Aphid populations on potato plants by using a basic sample of one plant, which is modified as the season advances to comprise three whole leaves arising from the main axis within the top, middle and lower thirds of the plant, or subunits of these. In 1941 and 1942, records were made on potato plants of several varieties in fields in Maine, to show by species and leaflet position all wingless Aphids on one leaf in each of the three levels on the plant, and the results were used to find suitable leaflet and half-leaflet sampling subunits. The Aphids found were *Aphis nasturtii* Kalt. (*abbreviata* Patch), *Myzus persicae* (Sulz.) and *Macrosiphum solanifolii* (Ashm.). Analysis of the results showed that subunits consisting of the terminal and two opposite basal leaflets of the three leaves resulted in about the same sampling accuracy as examination of the whole leaves and involved the investigation of only 42·9 per cent. as many leaflets and the counting of only 38·1 per cent. as many Aphids, and it is assumed that equally satisfactory estimates of very large populations could be obtained by making counts of the Aphids on only half of each sample leaflet, provided that opposite halves were examined on alternate plants. Appropriate conversion factors are given for expressing the estimates on a whole-leaf basis.

Gunther (F. A.) & Jeppson (L. R.). **Residues of *p*-Chlorophenyl-*p*-chlorobenzenesulfonate (Compound K-6451) on and in Lemons and Oranges.**—*J. econ. Ent.* **47** no. 6 pp. 1027–1032, 3 figs., 6 refs. Menasha, Wis., 1954.

Sprays of p-chlorophenyl p-chlorobenzenesulphonate are used for the control of *Paratetranychus* (*Metatetranychus*) *citri* (McG.) on *Citrus* in California. The authors describe a colorimetric method of determining the residues of this chemical on and in oranges and lemons and give an account of investigations on the penetration and persistence of them in the fruit. It is emphasised that the method does not distinguish between the intact compound and its possible hydrolysis product, p-chlorophenol.

A spray containing 0·75–1 lb. 50 per cent. wettable powder was applied at 1,000 U.S. gals. per acre to mature lemon trees and 1,500 U.S. gals. to

mature orange trees, and ripe fruits were collected from the periphery of the trees and analysed within two days. Extracuticular residue (adhering to the wax layer), cuticular residue (embedded or dissolved in the wax layer) and subcuticular residue (below the wax layer) were determined, as also were residues in the peel and pulp and in the juice. The results indicated that the half-life of residues of the acaricide in *Citrus* peel is about ten days and that it moves very quickly into the cuticular waxes, resulting in 75 per cent. loss from the surface within 2–3 days. The concentration within the wax layer reaches a maximum within 4–5 days and then seems to reach equilibrium as the acaricide traverses this layer, possibly in both directions. The acaricide penetrates into the peel, reaching a maximum level there within 9–11 days, and there are indications that some returns towards the fruit surface. After about 15 days, the residues show stable rates and directions of movement. The rapid disappearance of the subcuticular residue may be due partly to metabolic action in the peel, and comparison with the results of tests by a combustion technique to determine organic chlorine indicated that some of the dissipated p-chlorophenyl p-chlorobenzenesulphonate was metabolised to non-phenolic products. Practically no residue was found in the pulp.

It is concluded that little of the residue on and in ripe oranges and lemons will be removed by the usual packing-house treatments, but that scarcely any penetrates to the juice.

Gunther (F. A.), Barkley (J. H.) & Ewart (W. H.). **Harvest Residues of apparent Dieldrin in Peel and Juice of Navel Oranges.**—*J. econ. Ent.* **47** no. 6 pp. 1033–1035, 5 refs. Menasha, Wis., 1954.

In further investigations by a more sensitive and reliable method on the residues of dieldrin in sprayed navel oranges in California [*cf. R.A.E.*, A **41** 72], some of the trees were treated with 1 lb. 50 per cent. wettable dieldrin in 100 U.S. gals. spray per acre or 2·8 U.S. pints 18·5 per cent. emulsifiable concentrate in 200 U.S. gals. per acre on 12th May 1952, when the fruits were 1 cm. in diameter, and the others with the same quantities and formulations of dieldrin on both 12th May and 18th August, when they were still green but almost full-sized, in 200 U.S. gals. per acre on the first date and 100 U.S. gals. on the second. Analysis at harvest of fruits from these trees and from trees not treated with dieldrin or any other halogen-containing insecticide in 1952 showed that treatment in May only did not lead to any measurable dieldrin residues, whereas treatment in May and August resulted in an average of 0·08 part per million apparent dieldrin in the peel and less than 0·01 p.p.m. in the juice, based on fresh weight. Tests in which known amounts of dieldrin were added during the stripping of unsprayed fruits showed that 93–100 per cent. of the compound was recovered by the method used.

Painter (R. H.). **Some ecological Aspects of the Resistance of Crop Plants to Insects.**—*J. econ. Ent.* **47** no. 6 pp. 1036–1040, 26 refs. Menasha, Wis., 1954.

The following is based partly on the author's summary. Resistance of crop plants to insects is inherited as the tendency of a variety to support a lower insect population or to be injured less under given environmental conditions, and ecology is therefore important in its development, since physical, biotic and edaphic factors all affect the expression of genes for resistance. In some situations, ecological conditions unfavourable to the insect have increased the value of resistance beyond that to be expected

on the basis of cage and nursery studies. After the resistant wheat variety Pawnee had been introduced in central Kansas, the population of the hessian fly [*Mayetiola destructor* (Say)] decreased in spite of favourable weather conditions as the acreage of Pawnee increased, and since 1948, when the acreage has remained fairly constant and the weather has been unfavourable to the insect in several seasons, it has become almost impossible to find, even in the most favourable situations. This reduction is much greater than was expected from nursery tests, in which Pawnee wheat was about half as much infested as susceptible wheat, and is probably due to the combined effect of resistance and unfavourable weather.

Frost jr. (M. H.), Anderson (L. D.) & Elmore (J. C.). **Effect of certain Insecticides and Fungicides on Plant Emergence and Control of the Seed-corn Maggot.**—*J. econ. Ent.* **47** no. 6 pp. 1040–1045, 9 refs. Menasha, Wis., 1954.

The following is based on the authors' introduction and summary. *Hylemyia cilicrura* (Rond.) and various fungi attack sprouting seeds in California during late winter and early spring, particularly during periods of high humidity, and investigations were carried out in 1953 to determine the effect of seed treatment with dieldrin or lindane [almost pure γ BHC], combined with inert carriers or fungicides, on the development of the seedlings of various plants.

Seeds of nine varieties of cucurbits were treated with 0·33, 0·66 or 1·5 oz. 75 per cent. lindane or dieldrin in 1·5 or 3 oz. 75 per cent. thiram [tetramethylthiuram disulphide] or inert carrier per 100 lb., in slurries or dusts. Lindane and dieldrin were equally effective in controlling *H. cilicrura* at the three dosages tested, but when they were used without a fungicide, they permitted so much seed injury by decay organisms that plant emergence in the absence of the larvae was often lower than after no treatment.

When delinted cotton seeds were treated with 75 per cent. lindane at 0·33, 0·66 or 1·5 oz. in 1·5 or 3 oz. Ceresan M [7·7 per cent. ethyl mercury p-toluene sulphonanilide] or inert carrier per 100 lb. seed, in a slurry or dust, the results showed no significant differences in plant emergence between treatments, but the germination of machine-delinted cottonseed was better than that of acid-delinted seed. Seeds of green pea, onion and spinach were treated with 0·25, 0·5 or 1·5 oz. 75 per cent. lindane or dieldrin in 3 oz. 75 per cent. thiram or inert carrier per 100 lb. seed in dusts. Seedling emergence was not adversely affected, and the combinations of lindane and thiram gave better protection than the other treatments.

Metcalf (R. L.), March (R. B.), Fukuto (T. R.) & Maxon (M.). **The Behavior of Systox-isomers in Bean and *Citrus* Plants.**—*J. econ. Ent.* **47** no. 6 pp. 1045–1055, 4 figs., 14 refs. Menasha, Wis., 1954.

The following is based on the authors' summary of this account of investigations on the comparative behaviour of the two isomers present in Systox, O,O-diethyl O-2-(ethylmercapto)ethyl thiophosphate [demeton-O] and O,O-diethyl S-2-(ethylmercapto)ethyl thiophosphate [demeton-S], labelled with ^{32}P, in bean plants and lemon seedlings [*cf. R.A.E.*, A **43** 405]. The isomers were readily absorbed by the roots and stems of the lemon seedlings and translocated to the leaves in amounts toxic to *Paratetranychus* (*Metatetranychus*) *citri* (McG.), and *Heliothrips haemorrhoidalis* (Bch.). The translocated materials were present in greater quantity in the peripheral growing areas of the upper leaves, and the systemic behaviour closely

resembled that of schradan. After topical application to the stems, radioactivity accumulated in the upper leaves of bean and lemon 5–10 times as fast for demeton-S as for demeton-O. Studies of the quantitative metabolism of the two isomers in bean and lemon leaves by paper chromatography indicated a rapid metabolism of both. In the bean plants, 80–90 per cent. of both isomers was metabolised within 24 hours. Metabolism was slightly slower in the lemon seedlings, but 97–100 per cent. was metabolised within four days. The results of two independent sets of paper chromatographic studies with different solvents and stationary phases indicated that a single toxic metabolite comprises about 90 per cent. or more of the initial metabolic products for each of the isomers.

Contact toxicity studies in which oranges were dipped in standard solutions and the dry residues tested showed that demeton-S is 3–5 times as toxic as demeton-O to *P. citri* and *H. haemorrhoidalis*; the metabolite of the former caused total mortality at an estimated concentration of less than 40 mmg. per gm. leaf, and the metabolite of the latter at about 300 mmg. per gm. Pure demeton-O was a poor inhibitor of fly-brain cholinesterase, but demeton-S and the principal metabolites of both isomers were highly active [*cf.* **41** 358]. No radioactive vapours were recovered from the leaves of plants of which the stems had been treated with the radioactive isomers.

McConnell (E.) & Cutkomp (L. K.). **Studies with *Bacillus thuringiensis* in Relation to the European Corn Borer.**—*J. econ. Ent.* **47** no. 6 pp. 1074–1082, 2 figs., 20 refs. Menasha, Wis., 1954.

The following is partly based on the authors' summary of this account of preliminary tests in Minnesota in 1951 on the effectiveness of *Bacillus thuringiensis* for the control of *Pyrausta nubilalis* (Hb.) on maize. In the laboratory, maize husks were dipped in spore suspensions, and then shaken and drained for five minutes, after which larvae were allowed to feed on the inner surfaces for 36 hours at a temperature of 30°C. [86°F.]. Mortality of first-instar larvae increased with spore concentration, the median lethal concentration being about 50,000 spores per ml. Only one of five fourth-instar larvae that fed on husks dipped in four million spores per ml. and two of ten exposed to three million spores per ml. died, so that there may be a direct relation between the size or age of the larvae and the number of spores that must be ingested to cause death. There was no evidence of a repellent effect on first-instar larvae, and the rate of infection was positively correlated with temperature within the range 20–35°C. [68–95°F.]. The ingestion of a lethal dose of spores by a susceptible larva resulted in the rapid destruction of all but the sclerotised portions of the insect. In tests of the closely related *Bacillus cereus*, first-instar larvae suffered no appreciable mortality when exposed to the spores at a concentration exceeding the lethal level for *B. thuringiensis*. Field tests with plants that were sprayed with spore suspensions and infested with *P. nubilalis* indicated that concentrations that produced heavy larval mortality in the laboratory would not necessarily give significant control in the field, mainly because the young larvae often go deep into the whorl of the plant and so avoid exposure to the spores.

Sherman (M.) & Rosenberg (M. M.). **Subchronic Toxicity of four Chlorinated Dimethanonaphthalene Insecticides to Chicks.**—*J. econ. Ent.* **47** no. 6 pp. 1082–1083, 3 refs. Menasha, Wis., 1954.

In further tests of the effect of aldrin, dieldrin, isodrin and endrin on chicks [*cf. R.A.E.*, A **42** 296], carried out to investigate their subchronic

toxicity, aldrin and dieldrin were added to a standard starter ration at rates of 50, 25, 12·5 and 6·25 parts per million and isodrin and endrin at 12, 6, 3 and 1·5 p.p.m., and New Hampshire chicks a week old were fed on untreated or treated food for 42 days. Food consumption was recorded during the first two weeks, body weights were measured weekly and mortality was recorded from daily inspection. Aldrin and dieldrin caused about 20 per cent. mortality at 50 p.p.m., the birds dying in 16–34 days, which does not accord with the results of other investigators [**40** 121, 177], and isodrin and endrin killed over 90 per cent., mostly within a week, at 12 p.p.m. There was hardly any mortality at the lower dosages. Endrin and isodrin at the two highest rates and aldrin and dieldrin at the highest caused excitability, but lower dosages appeared to have little or no such effect. The survivors were sexed and weighed at seven weeks of age, and it was found that the females that received dieldrin, endrin or isodrin at the two highest rates or aldrin at the highest and males that received aldrin or dieldrin at the highest rate or endrin at 6 p.p.m. (all those treated at 12 p.p.m. having died) showed lower weight gains than the others. Endrin and isodrin at 12 p.p.m. markedly reduced food consumption.

Iglinsky jr. (W.) & Rainwater (C. F.). **Life History and Habits of *Tetranychus desertorum* and *bimaculatus* on Cotton.**—*J. econ. Ent.* **47** no. 6 pp. 1084–1086, 6 refs. Menasha, Wis., 1954.

The authors describe methods used to rear *Tetranychus desertorum* Banks and *T. bimaculatus* Harvey on seedling cotton grown in nutrient solutions in the laboratory in Texas in 1948–49. Both sexes of both mites were found to have a larval and two nymphal stages, each followed by resting stages. The egg, larval, protonymphal and deutonymphal stages of *T. desertorum* lasted 1·9–5·1, 1–2, 1·1–2·2 and 1·4–3 days, respectively, at average temperatures and relative humidities of 76–92°F. and 40–60 per cent., and those of *T. bimaculatus* 1·6–3, 1–1·8, 1–2 and 1·2–2 days at 84·4–91·4° and 42–50·4 per cent. Development from egg to adult was completed in 5·8–11·2 days for *T. desertorum* and 5·1–8·8 for *T. bimaculatus*.

Eggs from unfertilised females gave rise to males only and those from fertilised examples to a preponderance of females. Pairing in both directions was observed but as only males developed from the eggs produced, it is probable that fertilisation did not take place.

Tashiro (H.) & White (R. T.). **Milky Diseases of European Chafer Larvae.**—*J. econ. Ent.* **47** no. 6 pp. 1087–1092, 7 refs. Menasha, Wis., 1954.

An account is given of investigations in New York to determine whether *Bacillus popilliae* and *B. lentimorbus*, which cause the milky diseases of the larvae of *Popillia japonica* Newm. known as types A and B, respectively, could be used against larvae of *Amphimallon majalis* (Razoum.) [*cf. R.A.E.*, A **35** 200], which resemble the larvae of *P. japonica* in habit. Five disease strains were used, referred to as regular types A and B, type A *anxia* strain [derived from *Lachnosterna anxia* (Lec.) (*cf.* **30** 122; **32** 423)], type A Stanton strain (derived from naturally infected larvae of *A. majalis* found at Marion, N.Y., in 1952) and type B *Amphimallon* strain (from naturally infected larvae of *A. majalis* found at and near Port Gibson in 1951). The survey during which the last two strains were found showed that small numbers of larvae were naturally infected with milky disease of various types in several scattered localities in New York.

Suspensions of the spores of the regular types A and B, type B *Amphimallon* and type A Stanton strains were used in injection tests and dusts of the first three and the type A *anxia* strain in ingestion tests with third-instar larvae of *A. majalis* in the laboratory. The regular type B strain showed low pathogenicity by both methods of infection, but the others were highly pathogenic. When injected at the rate of a million spores per larva they infected 95–100 per cent. of the insects in two weeks at a temperature of 80°F., and when injected at 100,000 per larva, they caused infection in 6, 2, 1 and 1 weeks at incubation temperatures of 60, 70, 80 and 90°F., respectively. The type B *Amphimallon* and type A Stanton strains caused more rapid development of disease and a slightly higher incidence than the regular type A strain. In the feeding tests, which were made in soil containing between 250 million and 2,000 million spores per kg., 31–70 per cent. of the larvae became infected after incubation for four weeks, with no differences in disease incidence between type B *Amphimallon*, regular type A and type A *anxia* strains and no correlation between incidence and spore concentration in the soil. Field tests were begun in 1945 [*cf.* **35** 200], and it is stated that infected larvae were recovered from 15 of 17 plots in which spores of various strains of the two types were distributed since 1945, so that milky disease shows promise of giving economic control.

Glass (E. H.). **Field Evaluation of Insecticides against Codling Moth.**—*J. econ. Ent.* **47** no. 6 pp. 1093–1101, 4 refs. Menasha, Wis., 1954.

The following is based on the author's summary. The results are given of field tests with various insecticides against the codling moth [*Cydia pomonella* (L.)], made in 1948–53 in two apple orchards in New York in which heavy populations were maintained by leaving half or more of the trees untreated with insecticides. A programme of three cover sprays against the first generation and two against the second was used each year, and all spray quantities are given per 100 U.S. gals.

The standard sprays of 2 lb. 50 per cent. or 1·33 lb. 75 per cent. wettable DDT gave consistently excellent control except in 1949, when unusually warm weather favoured the moth and DDT was not completely effective, though better than the other materials tested. Lead arsenate at 3 lb. gave relatively poor control in most tests, 2 lb. 50 per cent. CS-708 [a 1:2 mixture of 1,1-bis(p-chlorophenyl)-2-nitropropane and 1,1-bis(p-chlorophenyl)-2-nitrobutane] was about equal to DDT, and 2 lb. 50 per cent. p,p′methoxy-DDT (methoxychlor) was slightly less effective; 2 lb. 50 per cent. DDD or 1 U.S. quart 25 per cent. DDD emulsion concentrate was still less effective but superior to lead arsenate, and Q-137 [1,1-bis(p-ethylphenyl)-2,2-dichloroethane (ethyl-DDD)] was unsatisfactory.

Phosphate insecticides were generally toxic, but were inferior to DDT for the prevention of late entries when used in a full-season programme. Parathion, used at 1–2 lb. 15–25 per cent. powder, was one of the most effective, followed by EPN [ethyl p-nitrophenyl thionobenzenephosphonate], used at 1 lb. 30–31·5 per cent. powder and malathion, used at 2 lb. 25 per cent. powder or 1 U.S. pint 50 per cent. emulsion concentrate; 2 lb. 25 per cent. Diazinon [O,O-diethyl O-2-isopropyl-4-methyl-6-pyrimidinyl thiophosphate] and 4389 (O,O-dimethyl S-(1,2-dicarbethoxyethyl) thiophosphate) were tested in 1952 with excellent results.

The numerous other organic compounds tested showed little promise, and it is concluded that DDT remains the best insecticide for the control of *C. pomonella* in New York and that there is little likelihood that any of the materials now available will take its place as long as resistance to it does not develop.

Carter (Walter). **Dichloropropane-dichloropropene Mixtures of different Composition as Soil Fumigants in Pineapple Land.**—*J. econ. Ent.* **47** no. 6 pp. 1101–1103, 1 ref. Menasha, Wis., 1954.

The results are given of tests in which three series of mixtures of chlorinated propanes and chlorinated propenes were compared with D-D mixture, a standard commercial preparation of 1,3-dichloropropene and 1,2-dichloropropane that has proved useful as a soil fumigant for the control of pests of pineapple in Hawaii [*cf. R A.E.*, A **34** 135]. They were injected through the mulch paper under normal planting conditions in all but one test, in which they were broadcast, and evaluated on the basis of plant-growth response as measured by fruit weight. The results indicated that 1,3-dichloropropene is an essential component, and that mixtures of compounds with boiling ranges of about 70–140°C. including at least about 30 per cent. 1,3-dichloropropene merit further investigation; they should contain a minimum of compounds with the higher boiling points, since these are phytotoxic.

Laudani (H.) & Swank (G. R.). **A Laboratory Apparatus for determining Repellency of Pyrethrum when applied to Grain.**—*J. econ. Ent.* **47** no. 6 pp. 1104–1107, 1 fig., 1 ref. Menasha, Wis., 1954.

As it was observed in Georgia that flour beetles (*Tribolium* spp.) were repelled by pyrethrum-treated paper long after any mortality or knock-down was caused by contact with it, an apparatus was designed to determine whether pyrethrum-treated grain was also repellent. It consisted essentially of 12 removable cups (for grain samples) inserted into holes arranged round the periphery of a circular rimmed enclosure and a lid through which insects could be liberated into the centre of the enclosure. Repellency was measured by comparing the numbers of insects in treated and untreated grain samples after a suitable interval. In one test with the flour beetles, 75·2 per cent. of those in the cups after three hours were found in untreated maize and 18·2 and 6·6 per cent. in that treated with pyrethrins at 0·25 and 0·37 part per million, respectively, in a spray, and similar results were obtained after exposure of the insects for 17 hours. A mixed batch of adults of *Oryzaephilus surinamensis* (L.), *Rhizopertha dominica* (F.) and *Lophocateres pusillus* (Klug) exposed for 17 hours to wheat treated with 0·1 and 0·3 p.p.m. pyrethrins in a dust showed similar trends, though the figures differed somewhat between species, and when adults of these and of *Tribolium* spp., *Lasioderma serricorne* (F.) and *Calandra* (*Sitophilus*) *oryzae* (L.) and larvae of *Attagenus megatoma* (F.) (*piceus* (Ol.)) were tested with whole black pepper [*Piper nigrum*] dusted with pyrethrins at 0·1 and 0·3 p.p.m. or 0·5 and 1 p.p.m., *Tribolium* reacted in the same way as to the treated maize, the other adult insects showed less pronounced preference for the untreated samples, and the larvae distinguished hardly at all.

Laudani (H.) & Clark (P. H.). **The Effects of Red, White, and South American Cedar Chests on the various Stages of the Webbing Clothes Moth and the Black Carpet Beetle.**—*J. econ. Ent.* **47** no. 6 pp. 1107–1111, 3 refs. Menasha, Wis., 1954.

The following is substantially the authors' summary. Tests were carried out at Savannah, Georgia, with chests of red, white and South American cedar (*Juniperus virginiana*, *Chamaecyparis thyoides* and *Cedrela odorata*) to determine the toxicity of the vapour given off by them to the various

stages of *Attagenus megatoma* (F.) (*piceus* (Ol.)) and *Tineola bisselliella* (Humm.) [*cf. R.A.E.*, A **41** 260–261, etc.], the insects being exposed with woollen cloth in cages in the chests at 80°F. and 60 per cent. relative humidity. Chests of white pine (*Pinus strobus*) were used for comparison.

All the cedar chests had an inhibiting effect on the hatching of eggs of both species laid in the chests but little or none on eggs introduced when one day old. Larval mortality was increased, the mortality of the younger larvae being much higher than that of mature larvae after exposure for a month or more in the chests, and full-grown larvae of *Tineola* were more susceptible than those of *Attagenus*. *Cedrela* chests made four months previously were more effective against both species than were the other chests, but they had lost practically all their effectiveness 12 months later. Chests of *Juniperus* retained their effectiveness for longer than the others, but their toxicity to larvae of *Attagenus* began to fall off sharply 24 months after they were made. The *Chamaccyparis* chests were never as effective as the others, and toxicity to *Attagenus* larvae began to decline 16–20 months after they were made.

The exposure of mature larvae had little or no effect on pupation and adult emergence of either species. Exposure of *Attagenus* adults did not cause mortality in excess of that in the pine chests and did not significantly inhibit oviposition. Exposure of *Tineola* adults resulted in some mortality, but pairing occurred and considerable numbers of viable eggs were laid.

Arthur (B. W.) & Arant (F. S.). **Effect of Systemic Insecticides upon certain Peanut Insects and upon Peanuts.**—*J. econ. Ent.* **47** no. 6 pp. 1111–1114, 6 refs. Menasha, Wis., 1954.

In further investigations on the relation of damage by *Frankliniella fusca* (Hinds) to yield of groundnuts in south-eastern Alabama [*cf. R.A.E.*, A **43** 41], carried out in 1952–53, the systemic insecticides demeton [diethyl 2-(ethylmercapto)ethyl thiophosphate], schradan, chlorthion (O,O-dimethyl O-3-chloro-4-nitrophenyl thiophosphate) and Compound 21/116 (O,O-dimethyl O-2-(ethylmercapto)ethyl thiophosphate) were compared with DDT and toxaphene for thrips control, and their effect on plant growth and yield determined. Demeton in a 50 per cent. emulsion concentrate diluted with oil was applied to the soil at 1 lb. per acre on 9th April 1952 and 11th April 1953, ten days before sowing, and foliage sprays of 0·5 lb. demeton and 1 lb. schradan per acre were applied on 7th May 1952 and 9th May 1953, 1 lb. DDT and 2 lb. toxaphene on 7th–19th May 1952 and 9th–25th May 1953 and 0·5 lb. chlorthion and Compound 21/116 on 9th May 1953. All treatments gave considerable control. Demeton was more effective when applied to the soil or to soil and foliage than when applied to the foliage only, giving better control than schradan, chlorthion or Compound 21/116 and was as effective as DDT and toxaphene, with a more persistent effect, some control being given for two months after application to the soil. Large numbers of Lepidopterous larvae, mainly *Heliothis armigera* (Hb.) and *Laphygma frugiperda* (S. & A.) were found on the foliage in summer, and counts made before and after sprays were applied showed that none of the systemic insecticides controlled them. When several applications were made, demeton applied at 30-day intervals throughout the growing season apparently retarded the growth of the plants, and demeton, schradan and chlorthion caused some scorching of the leaves when the plants were young. There was no significant increase in yield whether the systemic insecticides were applied to the soil or the foliage. In 1953, two early applications of DDT or toxaphene against the thrips resulted in yield increases that approached significance.

Fluke (C. L.) & Dever (D. A.). **Soil Application of Insecticides to control Plum Curculio.**—*J. econ. Ent.* **47** no. 6 pp. 1115–1117, 11 refs. Menasha, Wis., 1954.

The results are given of tests in Wisconsin, in which aldrin, dieldrin, chlordane, lindane [almost pure γ BHC] and EPN-300 [ethyl p-nitrophenyl thionobenzenephosphonate] were applied at 6 lb. per acre in water to orchard soil in early June 1951 and apples infested with eggs and larvae of the plum curculio [*Conotrachelus nenuphar* (Hbst.)] were placed in cages over the treated plots in the spring and early summer in 1951, 1952 and 1953, and of similar tests in which all but EPN, which showed poor residual effect in the earlier one, were applied at 3 or 6 lb. per acre in June 1952 and infested apples were placed in the cages in July 1952 and 1953. Counts of living adults in May and June in 1952, 1953 and 1954 showed that aldrin and dieldrin almost completely prevented adult emergence from the soil in all three years, whereas chlordane and lindane gave variable results, possibly owing to differences in soil type. Apples infested with larvae of the apple maggot [*Rhagoletis pomonella* (Walsh)] were added to the cages of the first series in the autumns of 1951 and 1952, but none of the insecticides reduced emergence appreciably.

In field tests in 1954 in an orchard of sour cherries with a previous history of heavy infestation by *C. nenuphar*, aldrin, dieldrin and heptachlor applied to the soil at 6 lb. in 900 U.S. gals. water per acre, in plots of $\frac{1}{5}$ acre, resulted in 4, 5·5 and 2·7 per cent. infested fruits on the trees, respectively, the same materials at 3 lb. in 4·5, 7·5 and 3·5 per cent., and no treatment in 6·8 per cent. As the average infestation was about 50 per cent. in neighbouring orchards in 1954, the treatments are considered to have given effective control.

Davis (E. W.), Landis (B. J.) & Gibson (K. E.). **Aphid Collections in the Yakima Valley of Washington, 1947–53.**—*J. econ. Ent.* **47** no. 6 pp. 1117–1121, 7 refs. Menasha, Wis., 1954.

A list is given of 139 species of Aphids taken in the Yakima Valley of Washington in 1947–53 in the course of studies on the bionomics and control of Aphids attacking potato. They include 12 not previously recorded for the Rocky Mountain region and 12 previously reported as rare there. The list shows the earliest and latest dates of capture and the species found on the plants examined to determine their importance as food-plants of *Myzus persicae* (Sulz.) and *Macrosiphum solanifolii* (Ashm.). Of the Aphids trapped in flight in 1952 and 1953, about 66 per cent. were caught at ground level and 15, 9, 6 and 4 per cent. at heights of 5, 10, 15 and 20 ft. above ground.

Swenson (K. G.). **Aphid Transmission of a Bean Yellow Mosaic Virus.**—*J. econ. Ent.* **47** no. 6 pp. 1121–1123, 1 fig., 10 refs. Menasha, Wis., 1954.

The bean yellow mosaic virus (bean virus 2, *Phaseolus* virus 2) [*cf. R.A.E.*, A **22** 219] causes an important disease of beans and peas in the United States, is commonly found in red clover (*Trifolium pratense*) and sweet clover (*Melilotus*) and is harboured by *Gladiolus*. A virus thought to be identical with it was recently isolated from naturally infected red clover near Geneva, New York, and studies were made on its host range and transmission by Aphids. In tests with Aphids, the latter were allowed to feed for several hours on the source plant and then for two days on the

test plant, in batches of ten. In most tests, five plants of Alaska pea, which readily shows mosaic symptoms, were infested at the same time as the test plants, and at least two always became infected. The symptoms of the virus and its relations to others are discussed. It was transmitted by *Myzus persicae* (Sulz.) to beans (*Phaseolus vulgaris*), peas, *Trifolium hybridum*, *T. pratense*, *Melilotus alba* and vetch (*Vicia sativa*), by *Macrosiphum pisum* Harris (*pisi* (Kalt.)) to the first two of these and *T. incarnatum*, and by mechanical means to the first of them and broad bean (*V. faba*), but not by the Aphids to lucerne, soy bean or *T. repens*, and not mechanically to cowpea (*Vigna unguiculata* (*sinensis*)) or cucumber. It was also transmitted to peas by *M. solanifolii* (Ashm.), but not by *Brevicoryne brassicae* (L.). Tests in which *M. pisum* was allowed to feed on diseased plants of *T. hybridum* for three minutes and then on healthy Alaska pea plants for two hours after intervals of 0·25–6 hours showed that the virus was retained for between four and six hours, with no reduction in the rate of transmission during the first half hour but considerable reduction thereafter. Starving the Aphids before feeding them on the source plant practically doubled the rate of transmission.

It is concluded that a virus that is retained in its vectors for such a short period will not be as effectively spread as one that is retained for longer and that a virus that does not infect lucerne is likely to be of much less importance to peas in western New York than one that does, as lucerne is the source of most of the Aphids that migrate to peas.

Eden (W. G.). **Control of Corn Earworm and Stored Grain Insects in Single-cross Corn.**—*J. econ. Ent.* **47** no. 6 pp. 1124–1126, 12 refs. Menasha, Wis., 1954.

Heliothis armigera (Hb.) and insects that are normally pests of stored grain, especially *Calandra* (*Sitophilus*) *oryzae* (L.) and *Sitotroga cerealella* (Ol.), do severe damage to the pure lines and single crosses of maize grown in Alabama, and an experiment on their control was carried out in 1953. DDT was applied at 2 lb. per acre in emulsion sprays, with or without 1·5 U.S. gals. mineral oil per acre, 4–7 times at three-day intervals between 10th and 27th July, and the maize was harvested in early September. All treatments reduced the damage by *Heliothis*; 5–7 applications of DDT with oil resulted in 22–26·5 per cent. ears undamaged and 8·7–10·6 per cent. lightly infested (damaged for not more than 0·5 inch from the tip) and four in 8·7 per cent. undamaged and 4·3 per cent. lightly infested, as compared with 4·1–9·9 per cent. undamaged and 2·9–7·8 per cent. lightly infested for 4–7 sprays of DDT alone; 43·2–66·2 per cent. of all plants showed medium damage (not over 1·5 inches into the ear from the tip) and 54 per cent. of untreated and 16·5–31·7 per cent. of treated ones heavy damage (over 1·5 inches). Whether DDT was used alone or with oil, 6–7 applications were more effective than 4–5. Untreated and treated maize showed 12·5 and 3·4–4·8 per cent. damage due to the stored-grain insects, *C. oryzae* and *S. cerealella* being primarily responsible. The yields from DDT alone were invariably better than those from DDT with oil, four applications giving the best result.

Hopkins (L.) & Carruth (L. A.). **Insects associated with Salt Cedar in southern Arizona.**—*J. econ. Ent.* **47** no. 6 pp. 1126–1129, 1 ref. Menasha, Wis., 1954.

Tamarix gallica, which is native to the Mediterranean region, is established in the southern and western United States, particularly along streams and

irrigation ditches, from near sea-level to elevations of 5,000 ft., and causes serious depletion of limited water supplies. Surveys were made from November 1951 to May 1953 on the insects that occur on it in southern Arizona, and an annotated list is given of the species found, with notes on their status and activities. There was no evidence that its growth and spread in the vicinity of irrigated agricultural districts could be limited by native insects.

A list of insects, none of them particularly destructive, found by J. K. Holloway on *T. gallica* in Spain during the summer of 1953 is appended.

HANNA (R. L.). **Application Schedules for Control of Cotton Insects.**—*J. econ. Ent.* **47** no. 6 pp. 1129–1131, 1 ref. Menasha, Wis., 1954.

An account is given of further investigations on the comparative value of treatments made early and late in the season for the control of cotton pests in Texas [*cf. R.A.E.*, A **42** 88]. The early treatments comprised two applications of 2 per cent. dieldrin dust at 5 lb. per acre on 29th May and 5th June against *Frankliniella tritici* (Fitch), or these two and a third at 12 lb. per acre on 16th June against this thrips and *Anthonomus grandis* Boh., and the late treatments consisted of five applications of 14 lb. of a mixture of 2·5 per cent. dieldrin, 5 per cent. DDT and 40 per cent. sulphur per acre at seven-day intervals or seven of the same dust at five-day intervals against *Heliothis armigera* (Hb.) between 5th July and 16th August, and all combinations of these and no treatments were tested.

Early treatments caused significant reductions of thrips with no significant difference between two and three applications. Infestation by *Anthonomus* was negligible. When no late treatments were given, early treatments caused significant reductions in injury by *Heliothis*, apparently by causing heavier growth at the beginning of the infestation period, and plants receiving three early treatments yielded significantly more seed cotton than those receiving two or none. Late treatments against *Heliothis* practically doubled the yield, and seven caused a greater increase than five. The best results were given by the plants that received the maximum number of treatments.

In a large-scale test on cotton planted in late May, in which all plots received eight late-season applications of standard insecticides and some received three early applications of toxaphene at 1 lb. per acre on 9th and 16th and at 1·5 lb. on 23rd June and some the last two, the last one or none, three early applications reduced the thrips population and caused slightly earlier fruiting, but failed to increase the yield significantly.

ELMER (H. S.) & EWART (W. H.). **Malathion and Malathion-Parathion Sprays for Control of the Soft Scale on *Citrus* in California.**—*J. econ. Ent.* **47** no. 6 pp. 1131–1133, 4 refs. Menasha, Wis., 1954.

In certain *Citrus* groves in California, outbreaks of *Coccus hesperidum* L. have followed applications of parathion for the control of other pests, apparently owing to the destruction of entomophagous insects, particularly *Metaphycus luteolus* (Timb.) [*cf. R.A.E.*, A **39** 337, 393]. Since parathion gives good control of several pests of *Citrus* in California and is widely used against *Aonidiella aurantii* (Mask.), *A. citrina* (Coq.) and *Coccus pseudomagnoliarum* (Kuw.), a suitable insecticide was needed for use against the occasional outbreaks of *C. hesperidum*. Laboratory and field tests in 1949–51 having shown that malathion was promising for this purpose,

further investigations were made in 1952–53 to determine the effectiveness of malathion, alone and with parathion, for the combined control of *C. hesperidum* and other Coccids. Sprays of 0·5, 1 and 1·5 lb. 25 per cent. wettable malathion per 100 U.S. gals., alone or with 0·5, 1 or 1·5 lb. 25 per cent. wettable parathion, were compared with sprays of 2 lb. 25 per cent. parathion in four *Citrus* groves, applications being made at the rate of about 25 U.S. gals. per tree between November and February, when parasite activity was slight. Comparison of populations of *C. hesperidum* on treated and untreated trees showed that malathion alone caused 78·3, 82·2 and 88·4 per cent. reduction at the three concentrations, respectively, and that these percentages were increased by the inclusion of parathion. Parathion alone caused a reduction of 39·8 per cent., and a combination of 1·5 lb. 25 per cent. wettable malathion and 0·5 lb. 25 per cent. wettable parathion per 100 U.S. gals. caused 94·4 per cent. and was the most effective treatment.

Elmore (J. C.) & Campbell (R. E.). **Control of the Pepper Weevil.**— *J. econ. Ent.* **47** no. 6 pp. 1141–1143, 4 refs. Menasha, Wis., 1954.

Anthonomus eugenii Cano is a serious pest of peppers [*Capsicum*] in the southern United States from California [*cf. R.A.E.*, A **23** 109] to Georgia and Florida, its northern limit varying with the severity of the winter cold. In southern California, it spread as far as Santa Barbara in 1940, but has retreated southward since 1946, owing to unfavourable winters and the general practice of eliminating its alternative food-plants in and near pepper fields. A similar succession of advance and retreat occurred in the Rio Grande Valley of New Mexico. Natural enemies do not afford much control, possibly because the immature weevils are protected in the pods, and no satisfactory insecticide for use against it was known until the discovery of DDT. This has been in common use since 1945; to be effective, it must kill practically all the adults present soon after it is applied and remain effective between treatments, and three applications at intervals of a week followed by two ten days apart have controlled heavy infestations.

In 1947, DDT and newer insecticides were compared for the control of *A. eugenii* on individual pepper plants in cage tests. When adults were introduced immediately after the plants had been dusted, mortality counts after 1–4 days showed that 10 per cent. DDT or chlordane, BHC diluted to give 2 per cent. γ isomer, and 1 per cent. parathion all gave 97–98 per cent. mortality, and 10 per cent. toxaphene, 1 per cent. lindane [almost pure γ BHC] and BHC to give 1 per cent. γ isomer gave 90, 88 and 82 per cent., respectively. Weevils on untreated plants suffered 8·6 per cent. mortality. In some tests, weevils were introduced five or ten days after treatment; DDT, 2 per cent. γ BHC and lindane had decreased in toxicity after ten days but not after five, whereas the other dusts were less toxic after five days and much less so after ten. In field-plot tests in the same year, in which 5 or 10 per cent. DDT, 2 per cent. γ BHC, 10 per cent. chlordane or toxaphene and 70 per cent. cryolite were applied at 25 lb. per acre once a week from 29th July to 9th September and weevils were counted 1, 3 and 5 weeks after the first application, DDT was as effective as the other insecticides under conditions of heavy reinfestation. All reduced the numbers of weevils and increased the yield, the increases being greatest for chlordane, BHC and 10 per cent. DDT.

In field tests in 1953 on the possible development of resistance to DDT, seven insecticidal dusts were applied at 30 lb. per acre on 17th and 27th July and 6th August and at 45 and 50 lb. on 25th August and 1st September to a field in which 75 per cent. of the early pods were infested. Examination

of pods for egg punctures on 24th August showed no significant reduction for any treatment, but on 8th September, 5 per cent. DDT, DDD (TDE), malathion and Q-137 [1,1-bis(p-ethylphenyl)-2,2-dichloroethane (ethyl-DDD)] showed 64, 49, 48 and 24 per cent. reduction and 2·5 per cent. aldrin, 3 per cent. heptachlor and 2 per cent. parathion 63, 50 and 24 per cent., as compared with no treatment, from which it is concluded that DDT is at least as effective as any of the other insecticides tried, but that frequent applications of a 10 per cent. dust are necessary if infestation is heavy.

Ivy (E. E.), Scales (A. L.) & Gorzycki (L. J.). **Three new Phosphate Insecticides for the Systemic Control of Cotton Insects.**—*J. econ. Ent.* **47** no. 6 pp. 1148–1149, 4 refs. Menasha, Wis., 1954.

An account is given of investigations carried out in Texas in which cottonseed was coated with O,O-diethyl S-isopropylmercaptomethyl dithiophosphate (TM 12008), O,O-diethyl S-propylmercaptomethyl dithiophosphate (TM 12009) or O,O-diisopropyl S-isopropylmercaptomethyl dithiophosphate (TM 12013) in an activated carbon carrier for tests of their systemic effect in protecting the plants against adults of *Anthonomus grandis* Boh., larvae of *Alabama argillacea* (Hb.) and other pests. They were applied at 4 lb. per 100 lb. seed, and the seedlings were infested with adults of *Anthonomus* or larvae of *Alabama*, which were left for five days. All three materials were initially very effective against both insects, and the first remained so against *Anthonomus* for four weeks and against *Alabama* for 5–6 weeks. When other pests were released on the plants three weeks after treatment, complete kill of *Aphis gossypii* Glov., *Tetranychus desertorum* Banks and adults of *Psallus seriatus* (Reut.) was given by all these compounds and of newly hatched larvae of *Bucculatrix thurberiella* Busck and *Estigmene acraea* (Dru.) by the first two but not by the third. The first was effective and the second less so against *Frankliniella tritici* (Fitch), the third not being tested, but none of them killed larvae of *Heliothis armigera* (Hb.). These compounds appear to be very effective against chewing insects and have little effect on seed germination.

Martin (D. F.) & Mistric jr. (W. J.). **A new Pest of Cotton in Texas.**—*J. econ. Ent.* **47** no. 6 pp. 1149–1150. Menasha, Wis., 1954.

The authors describe the egg, larva and adult of *Acontia dacia* Druce, which caused noticeable damage to the leaves of cotton in the south-central, eastern and upper coastal areas of Texas during the first week of July 1954 and severe damage over several thousand acres by the middle of the month. The insect had been taken in 1953, but no damage was then reported. Populations increased and became injurious in fields that were being treated with various chlorinated hydrocarbons recommended for the control of cotton pests. In preliminary laboratory tests, sprays of 0·125–0·25 lb. parathion and 0·25–0·5 lb. malathion per acre gave 100 per cent. control, and 0·25–0·33 lb. endrin gave 81–100 per cent., whereas sprays of 2–3 lb. toxaphene, 1–1·5 lb. DDT and 0·3–0·4 lb. γ BHC and dusts of 10–15 lb. cryolite or calcium arsenate were ineffective. In a field test, in which applications were made by aeroplane, 0·25 lb. parathion and 0·33 lb. endrin per acre, applied in sprays, gave 100 and 97 per cent. reduction in infestation in 24 hours, 0·4 lb. γ BHC per acre in a spray gave 77 per cent., and 10 lb. per acre of a dust containing 5 per cent. γ BHC, 10 per cent. DDT and 40 per cent. sulphur gave none.

Barr (W. F.) & Manis (H. C.). **The Red-headed Ash Borer in Idaho.**—*J. econ. Ent.* **47** no. 6 p. 1150. Menasha, Wis., 1954.

The Cerambycid, *Neoclytus acuminatus* (F.), infests a wide variety of deciduous trees in the eastern United States [*cf. R.A.E.*, A **28** 353], and its subspecies *N. a. hesperus* Linsley attacks oaks in Colorado. The typical form has not been recorded from west of the continental divide, but since 1948, many examples closely resembling it have been found in south-western Idaho, where it is apparently well established and a rather serious pest of black locust [*Robinia pseudacacia*]. Young trees in an apparently healthy condition were found to be heavily infested on several occasions, but older or weakened trees and freshly cut or seasoning wood were generally the most heavily attacked. The borer was also found in the wood of apple and has been reported as infesting soft maple and *Campsis* sp. in Idaho.

Eden (W. G.). **Control of the Strawberry Weevil in Blackberries.**—*J. econ. Ent.* **47** no. 6 pp. 1150–1151, 3 refs. Menasha, Wis., 1954.

Anthonomus signatus Say is an important pest of cultivated blackberries at Clanton, Alabama. In tests on its control in 1952–54, wettable-powder sprays of 1 lb. DDT or chlordane or 2 lb. toxaphene per 100 U.S. gals. were applied three times at intervals of 1–2 weeks from the time when the plants began to produce flower buds freely until 3–4 weeks before the first picking of ripe fruit. All treatments reduced the percentage of buds infested, and the average yield for the three years was significantly increased from 9,349 to 10,927, 10,101 and 11,195 lb. per acre, respectively.

Dahms (R. G.), Connin (R. V.) & Guthrie (W. D.). **Grasses as Hosts of the Greenbug.**—*J. econ. Ent.* **47** no. 6 pp. 1151–1152, 1 ref. Menasha, Wis., 1954.

The survival of *Toxoptera graminum* (Rond.) in summer in the United States depends on wild grasses and self-sown cereals, and greenhouse experiments were therefore carried out in Oklahoma and Kansas in which colonies of the Aphid were caged on seedlings of various grasses when these were 24–28 days old and counted eight days later. The results, which are summarised in a table showing the growing season of the plants and the increase in numbers of Aphids per parent, indicated that *Aegilops cylindrica*, *Cenchrus pauciflorus* and *Andropogon furcatus* were the most favourable in both States.

Eden (W. G.). **Control of the Sugarcane Beetle in Corn.**—*J. econ. Ent.* **47** no. 6 pp. 1155–1156, 2 refs. Menasha, Wis., 1954.

Adults of *Euetheola rugiceps* (Lec.) caused severe damage to maize in Alabama in 1954 by boring into the soil near the plants and feeding on the tender stems below the surface, usually killing young plants and sometimes severely stunting old ones. In tests on their control, maize sown on 7th May in a field in which two earlier sowings had been destroyed was treated with insecticides in emulsion sprays or granules (30–60 mesh) applied in an 8-inch band along the rows immediately after sowing. Technical aldrin was applied at 0·5, 1 or 2 lb. in 15 U.S. gals. spray per acre or as granules, and dieldrin, heptachlor and toxaphene at 1, 0·03 and 8 lb. per acre, respectively, in granules, and the stems were examined for injury on 2nd and 17th June, when damage was severe in untreated plots. On 2nd June, plots treated with aldrin or dieldrin showed significantly less damage than untreated ones,

aldrin in all plots was significantly more effective than toxaphene or heptachlor and 2 lb. aldrin in either form was significantly better than dieldrin. On 17th June, all treated plots showed significantly less injury than untreated ones. Aldrin was significantly more effective at 1 lb. as granules and at 2 lb. as spray or granules than dieldrin, heptachlor or toxaphene, but was not significantly better at 0·5 lb. than dieldrin or toxaphene; there was no significant difference between the latter.

Burkhardt (C. C.). **Control of Army Cutworms.**—*J. econ. Ent.* **47** no. 6 pp. 1156–1157. Menasha, Wis., 1954.

Chorizagrotis auxiliaris (Grote) is locally of major importance in Kansas each year. It damaged seedling lucerne in March 1954 and was present but not injurious in many wheat fields and established lucerne stands. In small-plot tests on lucerne, in which emulsion sprays were applied at 80 U.S. gals. per acre on 20th March, when the population consisted largely of fourth-instar larvae, and square-foot samples of the crop were examined on 1st April, 0·1–0·2 lb. endrin per acre gave 88 per cent. reduction in larval population, 0·25 lb. dieldrin, 0·25 and 0·5 lb. heptachlor and 0·5 lb. aldrin 80–84 per cent., and 0·25 lb. aldrin 72 per cent. In one-acre field plots to which emulsion sprays were applied at 5 U.S. gals. per acre on 22nd March, 0·2 lb. endrin and 0·5 lb. aldrin per acre gave 89 and 86 per cent. reduction by 31st March, 0·25 lb. dieldrin and 0·5 lb. heptachlor 78 per cent., and 2 lb. toxaphene 67 per cent. The quantity of spray per acre thus made little difference in control.

Tuttle (D. M.) & Butler jr. (G. D.). **The Yellow Clover Aphid—a new Alfalfa Pest in the Southwest.**—*J. econ. Ent.* **47** no. 6 p. 1157, 2 refs. Menasha, Wis., 1954.

Myzocallis (*Therioaphis*) *ononidis* (Kalt.) (*trifolii* (Monell)), which has long been known as a minor pest of clover in the central and eastern United States [*cf. R.A.E.*, A **3** 114], was found in the south-west for the first time in May–June 1954, when damaging infestations occurred on lucerne in southern Arizona. It was later reported from New Mexico and the Imperial Valley of California. Nymphs and adults were found on the lower surfaces of the leaves and first attacked the lower leaves, which dried and fell, so that hay yield and quality were reduced, and the copious honeydew made baling difficult. There were preliminary indications that the regrowth of injured plants after cutting was retarded and that seed yield was reduced.

In tests in which a tractor-mounted duster with a 30-ft. boom was used to apply insecticidal dusts to irrigated lucerne grown for hay near Yuma, Arizona, 5 per cent. malathion or chlorthion [O,O-dimethyl O-3-chloro-4-nitrophenyl thiophosphate], 2 per cent. parathion, 25 per cent. methyl-parathion and 4 per cent. Diazinon [O,O-diethyl O-2-isopropyl-4-methyl-6-pyrimidinyl thiophosphate] gave effective control and are considered promising for use on hay crops in view of their short residual effect. A mixture of 5 per cent. DDT and 15 per cent. toxaphene, with or without 40 per cent. sulphur, also gave good control and may be useful on crops grown for seed.

Douglas (W. A.). **Effect of Planting Date on Corn Earworm Damage to Dent Corn.**—*J. econ. Ent.* **47** no. 6 p. 1158. Menasha, Wis., 1954.

Investigations were carried out in Mississippi in 1945–48 to determine the best date for sowing dent maize so as to avoid injury by *Heliothis armigera*

(Hb.). Eight dates at 15-day intervals from 1st March to 15th June were tested in each year so far as weather permitted, and the maize was harvested in October. Individual ears showed least damage by *Heliothis* in the plots sown on 1st and 15th April and 1st May, probably because the moths were then dispersed over a large area, most of the dent maize in Mississippi being sown in April. Damage (estimated by rating each of 100 ears on a scale of 0 to 5) was heaviest in the plots sown on the last three dates, probably because large numbers of moths were concentrated in them. The percentage of ears infested was generally proportional to damage, and the quality of the maize was much better in the mid-season than in the early or late sowings. The earliest maize was somewhat damaged by birds and was the most heavily infested by *Calandra* (*Sitophilus*) *oryzae* (L.), and the last two sowings were most injured by diseases.

Finlayson (D. G.). **Note on the Effects of lethal Doses of Insecticides on Oviposition of the Tuber Flea Beetle, *Epitrix tuberis* Gent. (Coleoptera: Chrysomelidae).**—*Canad. J. agric. Sci.* **34** no. 3 pp. 320–322, 2 refs. Ottawa, 1954.

In recent experiments on the control of *Epitrix tuberis* Gentner on potato in British Columbia [*R.A.E.*, A **43** 358], insecticides applied to the foliage controlled the adults but did not cause a satisfactory reduction in the numbers of larvae and pupae of the next generation. In laboratory tests to determine the reason, adults collected in the field were kept in cages until the preoviposition period of six days was completed and then, after a further 24 hours, were confined with squares of green blotting paper that had been dusted with 5 per cent. DDT, 69 per cent. calcium arsenate or 10 per cent. toxaphene to give deposits of 12, 83 and 10 mmg. toxicant per sq. cm., respectively, or with squares of potato leaf that had been dipped in water containing 0·005 per cent. toxaphene, 0·005 per cent. DDT, 0·3 per cent. calcium arsenate or 0·005 per cent. DDT with 0·3 per cent. calcium arsenate and bore residues of 0·18, 0·24, 1·4 and 0·19 mmg. toxicant per sq. cm., respectively. All deposits except the toxaphene dust gave complete mortality in 96 hours, and all except the mixture of DDT and calcium arsenate caused significant reductions in oviposition. The average number of eggs laid per female in the first 24 hours after treatment was highest (two) among individuals caged with leaves dipped in sprays of calcium arsenate. Very few eggs were laid in any of the tests after 24 hours and none at all after 48 hours. It is concluded that the reason for the development of the immature stages in the earlier work was probably faulty timing of the treatments.

Wishart (G.) & Monteith (E.). *Trybliographa rapae* (**Westw.**) **(Hymenoptera: Cynipidae), a Parasite of *Hylemya* spp. (Diptera: Anthomyiidae).**—*Canad. Ent.* **86** no. 4 pp. 145–154, 14 figs., 18 refs. Ottawa, 1954.

During studies in Canada and Europe on the natural enemies of the larvae of *Hylemyia brassicae* (Bch.), *H. floralis* (Fall.) and *H. cilicrura* (Rond.), all of which attack cruciferous crops, many thousands of examples of these and other species of the genus were examined. The parasites reared included one Cynipid, *Trybliographa rapae* (Westw.), of which *T.* (*Cothonaspis*) *gillettei* (Wshbn.) [*cf. R.A.E.*, A **12** 535, etc.] is a synonym. This was reared in Europe from *H. brassicae*, *H. floralis* and *H. antiqua* (Mg.) in Norway, *H. brassicae* and *H. floralis* in Denmark, Sweden and Scotland,

and *H. brassicae* and *H. cilicrura* in Switzerland, France, Belgium, Holland and England, and in Canada from *H. brassicae* in almost every Province, *H. cilicrura* and *H. antiqua* in Ontario, Manitoba and British Columbia, *H. floralis* in Manitoba and Saskatchewan, and *H. planipalpis* (Stein) in Manitoba and British Columbia. The percentage parasitism in various hosts and countries or Provinces in 1949–51 is shown in a table and was highest (45·6) for *H. cilicrura* in Saskatchewan in 1951. The egg and larva and the reproductive organs of both sexes of *T. rapae* are described, and an account is given of observations on its bionomics.

The adults were sluggish, but pairing sometimes occurred immediately after emergence and both fertilised and unfertilised females sometimes oviposited within a few hours if host larvae were available. Most of the larvae attacked were embedded in subterranean plant tissues, and the parasite females penetrated as far as ½ inch into the larval burrows in search of them. Eggs were laid in bright light, in larvae that had been removed from the plants and washed [*cf.* **16** 540–541] and in larvae in all instars but the third, though oviposition in these was attempted. As many as 14 eggs were laid in one host in the laboratory, but the maximum number found in field-collected larvae was five, and where many hosts were present, most contained only one. The egg stage lasted about 96 hours at 75°F. and longer at summer ground temperatures. The first instar lasted from a few days to several weeks, its duration being determined by the temperature and by the stage at which the host larva was attacked, since the second instar was not entered until the host formed its puparium. The second and third instars lasted not more than 5–6 days at 75°F. Shortly after entering the third instar, the parasite left the host pupa and fed on it externally in the puparium for the rest of that instar (1–2 days) and during the next, which may last throughout the winter or be completed in a fortnight at other seasons. Pupation took place in the host puparium, and the adults emerged after about a week, the males before the females. Mortality during the winter or during artificial storage was low, and winter mortality was lower among the parasites than among unparasitised *Hylemyia* larvae, in which it was high under laboratory conditions. Since some first-generation individuals of *T. rapae*, like some of *H. brassicae*, do not complete their development until the following year [*cf.* **41** 5], it appears that the development of the parasite is influenced by that of the host. It enters diapause if, at the onset of cold weather, it is in or near the fourth instar or if it has developed in a univoltine host, although it may have been in the fourth instar for some time; many larvae found parasitising *H. brassicae* in swedes at harvest were in the fourth instar, whereas those observed in *H. floralis*, which develops more slowly, were in earlier stages.

The Staphylinids, *Aleochara bilineata* Gylh. [*cf.* **42** 170] and *A. bipustulata* (L.), are the only species numerous enough to compete with *T. rapae*. They feed externally on the host pupae, but usually attack them before *T. rapae* begins its period of external feeding and so destroy both host and parasite. Parasitism by *T. rapae* causes a reduction in the size of the puparia of *H. brassicae*, *H. floralis* and *H. cilicrura*, especially when the larvae are attacked in the first instar; in this event, the puparia of all three species are of comparable size, though they normally differ widely.

Wong (H. R.). **Common Sawflies feeding on White Birch in the forested Areas of Manitoba and Saskatchewan.**—*Canad. Ent.* **86** no. 4 pp. 154–158, 8 figs., 8 refs. Ottawa, 1954. **Erratum.**—*T.c.* no. 5 p. 203.

A list is given of 12 sawflies that are common on white birch (*Betula papyrifera*) in forested areas in Manitoba and Saskatchewan. They also

occur in eastern Canada and the United States. Six of them are confined to birch, and very brief notes are given on the alternative food-plants of the others and on the methods of feeding and some aspects of the bionomics of all. The only one recorded as causing any considerable damage during 1945–52 was *Arge pectoralis* (Leach), which is gregarious and severely defoliated white birch in south-eastern Manitoba in 1947 and 1948. A key for the separation of the late-instar larvae of all 12 species is included.

Holmes (N. D.). **Food Relations of the Wheat Stem Sawfly, *Cephus cinctus* Nort. (Hymenoptera: Cephidae).**—*Canad. Ent.* **86** no. 4 pp. 159–167, 12 figs., 7 refs. Ottawa, 1954.

Resistance to *Cephus cinctus* Nort. in wheat has been shown to be positively correlated with solidness of stem [*cf. R.A.E.*, A **35** 338]. Under certain environmental conditions, however, the resistant variety Rescue becomes susceptible to attack [*cf.* **37** 233], and since the nature of its resistance is not known, the nutritional requirements of the sawfly were studied to provide preliminary data for its investigation. Descriptions are given of the anatomy of the mouth parts, digestive tract and excretory organs of the larvae, together with an account of observations on the feeding process in wheat stems split longitudinally, of which the halves were placed separately in narrow glass tubes plugged at each end. These showed that the larvae feed chiefly on the parenchyma, to a less extent on the vascular tissue, and rarely on the hypodermis; the vascular bundles are severed at intervals throughout the internode, as a result of which the nutrients available to the developing kernels and, in consequence, the yield are reduced [*cf.* **35** 11]. Large fragments of parenchyma and vascular tissue apparently pass unchanged through the gut.

In qualitative tests of the digestive enzymes present in the larvae, amylase and sucrase were found in the mid-gut and labial glands, but not in the hind-gut, and cellulase was also present. Tests for maltase, lactase, pepsin and trypsin gave negative results, which, in the case of the last, may have been due to unfavourable experimental conditions, and the results with lipase were inconclusive, though some evidence of its presence was obtained. Amylase and sucrase were also found in the stems of wheat of the Thatcher variety.

Coppel (H. C.). **Notes on the Parasites of *Neodiprion nanulus* Schedl (Hymenoptera: Tenthredinidae).**—*Canad. Ent.* **86** no. 4 pp. 167–168. Ottawa, 1954.

In the course of work on the propagation of beneficial insects, eggs of *Neodiprion nanulus* (Schedl) were collected in 1943 and cocoons in 1943 and 1944 in a plantation of red pine (*Pinus resinosa*), Scots pine (*P. sylvestris*) and jack pine (*P. banksiana*) in Ontario that had been heavily infested by the sawfly in 1942. Parasites were obtained from about 39 per cent. of the cocoons and adults of *N. nanulus* from almost 60 per cent., while the rest had been destroyed by predators. A list of the parasites is given, showing the months of collection and the percentages of cocoons attacked. The most abundant was *Dahlbominus fuscipennis* (Zett.), which was reared from over 31 per cent. of the cocoons; this Eulophid was introduced from Europe and was the only one of four species that had been released against *N. nanulus* to be recovered. The next commonest was the Ichneumonid, *Endasys*

(*Stylocryptus*) *subclavatus* (Say), which emerged from 2·15 per cent. of the cocoons.

Wood (G. W.), Neilson (W. T. A.), Maxwell (C. W.) & McKiel (J. A.). **Life-history Studies of** *Spaelotis clandestina* **(Harr.) and** *Polia purpurissata* **(Grt.) (Lepidoptera: Phalaenidae) in Low-bush Blueberry Areas in New Brunswick.**—*Canad. Ent.* **86** no. 4 pp. 169–173, 7 refs. Ottawa, 1954.

An account is given of observations on the bionomics of *Spaelotis clandestina* (Harr.) (*Agrotis unicolor* (Wlk.)) [*cf. R.A.E.*, A **24** 155] and *Polia purpurissata* (Grote), two cutworms that occurred each year from 1947 to 1952 in commercial blueberry fields in New Brunswick, together with descriptions of the eggs of both and the larvae of *P. purpurissata*. *S. clandestina* occurs throughout Canada from Nova Scotia to British Columbia, throughout the United States as far south as Kentucky and California, and in Greenland. It is common on blueberry in New Brunswick and Maine and also attacks many other plants. In the insectary, egg-masses were usually laid under sand or débris. The egg stage occupied 27–57 days and probably lasts about 57 in the field. The larvae hatch in late October and November and pass through five instars, overwintering in the soil in the first. Second-instar larvae appear about the middle of April, and feeding continues at first on the young buds and later on the foliage, until late May or early June. In the insectary, it ceased five or six days before pupation, which occurred in the soil. The adults, which emerged about 30 days later, are present from early July until late September. In the insectary, they paired 6–8 weeks after emergence, and oviposition began about a week later. *Apanteles laeviceps* Ashm. and a species of *Microplitis* near *autographae* Mues. were reared from the larvae, and *Ichneumon* (*Pterocormus*) *rufiventris* Brullé from the pupae, but the total percentage parasitism did not exceed 20.

Polia purpurissata is recorded from Quebec and British Columbia and in the United States from Maine to New York and as far west as Utah and Colorado. In New Brunswick, it is one of the commonest cutworms in blueberry fields, where it also feeds on other shrubs and weeds. Eggs were not observed in the field, but in the insectary they were laid on the lower surfaces of the blueberry leaves or on the sides of the container and hatched in 8–15 days. The larvae appear about mid-August and overwinter in the soil, usually in the third or fourth instar, from the latter part of November. Feeding is resumed in early April and continues until late June or early July. Pupation takes place in the soil, and the adults, which emerge 6–7 weeks later and pair soon after, are present from late July until early September. Oviposition occurs in August or early September. *Echinomyia* (*Fabriciella*) *hispida* (Tothill) and *Ophion* sp. were reared from the larvae and *Therion nigrovarium* (Brullé), *Dibrachys cavus* (Wlk.) and undetermined species of *Coelopisthia*, *Eulophus* and *Gravenhorstia* from the pupae, total parasitism not exceeding 35 per cent. An egg-mass that was left out of doors was parasitised by a species of *Telenomus* near *graptae* How.

Rose (A. H.) & Blais (J. R.). **A Relation between April and May Temperatures and Spruce Budworm larval Emergence.**—*Canad. Ent.* **86** no. 4 pp. 174–177, 1 graph. Ottawa, 1954.

In north-western Ontario, the emergence of the second-instar larvae of *Choristoneura fumiferana* (Clem.) from the shelters in which they have

overwintered takes place suddenly in some years and gradually in others, and mass emergence varies considerably in date. An attempt was made in 1947–52 to relate emergence to temperature in April and May, the months during which it occurs, by correlating meteorological records with counts of the larvae in each instar on sample branches of balsam fir (*Abies balsamea*). It was found that the date of emergence was advanced or retarded according to whether the monthly temperature for April was above or below the average. May temperatures supplemented the effect. In each year of the investigation, peak emergence occurred after the temperature average over a five-day period reached or exceeded 60°F.; it was as early as 29th April in 1952 and as late as 24th May in 1950. Emergence took place immediately after 60°F. was reached if the rise in temperature was gradual, but was delayed if it was sudden. In 1949, temperatures after peak emergence (May 3rd) fell below 60°F., and 12 days later almost all the larvae were still in the second instar, but in 1948, temperatures after the peak (May 12th) exceeded 65°F. and almost 50 per cent. of the larvae reached the third instar within seven days. In 1952, maximum temperatures during 25th–30th April averaged about 80°F. and there was a large-scale emergence on 29th April. Subsequent temperatures were low and development was gradual, but the average maximum temperature rose to 74°F. during 20th–25th May, and there was a second peak of emergence about 22nd May, involving nearly two-thirds of the population; about 15 per cent. of the larvae had already reached the fourth instar by this date, though in normal years the two instars were rarely present together. An examination of temperature records and dates of emergence during 1946–50 at a place some 200 miles further east confirmed the relation found.

Sherwood (R. C.) & Pond (D. D.). **A simple Method of rearing** *Hylemya brassicae* **(Bouché) (Diptera: Anthomyiidae).**—*Canad. Ent.* **86** no. 4 pp. 178–179, 5 refs. Ottawa, 1954.

In view of difficulties experienced in rearing *Hylemyia brassicae* (Bch.) in the laboratory, a method by which a colony was maintained for 17 months is described. Adults were kept in a wire-screen breeding cage 48 × 24 × 29 ins. in size, of which the floor was supported on wooden slats at a height of 9 ins. above the greenhouse bench, the space beneath being filled with damp *Sphagnum* to a depth of 6 ins. to maintain a high humidity. Sugar solution and a food prepared by mixing maize meal with boiling water and adding unsweetened milk, molasses, wheat-germ oil, liver extract, and, when cool, turnip juice, were provided. For oviposition, a box 6 × 6 × 3 ins. containing a 2-in. layer of fine moist sand with a small turnip on it from which the tap root and root hairs had been removed was left in the cage for two or three days, during which eggs were laid in the sand. Several boxes were used. After oviposition they were removed to the greenhouse bench and the sand was lightly watered. The larvae hatched in 3–5 days, fed in the turnip for 20–30 days, and pupated in the sand. When pupation was complete, the boxes were either transferred immediately to the cages, where emergence began after 14–20 days, or stored at 35°F. When pupae were stored for up to five months, emergence began on the day after transference to the cages and continued for about 30 days; pupal mortality during storage was low. Emergence was favoured by temperatures fluctuating between 60 and 80°F. It did not occur when the pupae were kept at 60°F. for 60 days, but began as soon as they were transferred to fluctuating temperatures. Adults kept at 60–80 per cent. relative humidity with approximately 16 hours of light per day were very active and both pairing and oviposition occurred. The number of eggs laid per box was

200–300 and was highest when there were 150–200 adults per cage. To obtain first-instar larvae, slices of turnip in a petri dish were left in the cage overnight, when 50–75 eggs were usually obtained; these were incubated by a technique already noticed [*cf. R.A.E.*, A **16** 556].

Kelleher (J. S.). **Damage to Sweet Clover Seed by the Sweetclover Weevil,** *Sitona cylindricollis* **Fahr. (Coleoptera: Curculionidae).**—*Canad. Ent.* **86** no. 4 pp. 179–180. Ottawa, 1954.

Sitona cylindricollis Fhs. was reported as causing considerable reductions in seed yields of sweet clover [*Melilotus*] in Manitoba and Saskatchewan by feeding on the seeds or causing them to drop, and since this weevil is often numerous in seed crops, the extent to which it injures them was investigated in 1951–52. Adults were caged in the field on racemes of ripe or unripe seeds with and without the foliage and terminal buds or on the plants bearing them or were confined in the laboratory in vials containing racemes of unripe seeds with or without foliage or of ripe seeds without foliage. Damage to the seeds was greatest on unripe seeds in the absence of foliage, on which it reached 37·8 and 19·9 per cent. in the field and laboratory, respectively, and was only about 4 per cent. when foliage was also available. Ripe seeds and the pedicels of unripe ones were not attacked, and though some ripe seeds were detached from the racemes in the field, this was apparently due to wind, since it also occurred in cages without weevils but was not observed in the laboratory. The results suggest that the foliage is the preferred food.

Hall (R. R.), Downe (A. E. R.), MacLellan (C. R.) & West (A. S.). **Evaluation of Insect Predator-Prey Relationships by Precipitin Test Studies.**—*Mosq. News* **13** no. 3 pp. 199–204, 8 refs. Albany, N.Y., 1953.

Downe (A. E. R.) & West (A. S.). **Progress in the Use of the Precipitin Test in entomological Studies.**—*Canad. Ent.* **86** no. 4 pp. 181–184, 7 refs. Ottawa, 1954.

An account is given in the first paper of the technique used and results obtained in Canada in the experimental determination of the identity of the insects on which predatory insects had fed by means of the precipitin test. The work described in most detail concerned the larvae of the Lasiocampid, *Malacosoma disstria* Hb., and adults of the Reduviid, *Zelus exsanguis* (Stål), which are predacious on them. Cell-free extract for use as an antigen was prepared by starving the larvae, to allow the gut to empty, washing them and macerating them with an equal volume of buffered physiological saline. The mixture was refrigerated at 8°C. [46·4°F.] for 48 hours, filtered through a Buchner funnel, sterilised by passage through a Seitz filter and bottled. Merthiolate preservative was added to give a final dilution of 1:10,000, and the antigen was stored at 8°C. until required for use. Four successively increasing amounts of the antigen were then injected into a rabbit, which was bled for antiserum after the titre was found to be suitable. Antisera were Seitz-filtered and stored at −25°C. [−13°F.]. The titre was determined as the highest dilution of the antigen that gave a positive ring test with a constant dilution of antiserum. Titres of at least 1:5,000, using undiluted antiserum, were desirable for predator studies. Smears of the whole predator or its gut contents (or of the prey for positive controls) were made on filter paper and could be stored indefinitely in envelopes. For testing, the smear was soaked in a small amount of buffered

physiological saline, 0·2 ml. of the extract was underlayered in a test-tube with an equal volume of antiserum, the titre of which had been checked after thawing, and the tube was incubated at 37°C. [98·6°F.] for one or two hours. In positive tests, a precipitin ring appeared at the interface.

The antiserum gave precipitin rings with extracts of smears of larvae of both *M. disstria* and *M. americanum* (F.), but did not react with those from larvae of *Erannis tiliaria* (Harris). Positive reactions were also obtained with extracts of smears of adults of *Z. exsanguis* that had fed on larvae of *M. disstria* in the laboratory, whether the insects were used immediately after feeding or after being kept for up to 108 hours at 25°C. [77°F.] or up to 132 hours at room temperature ranging from 18°C. [64·4°F.] to 25°C.; of ten extracts tested after 144 hours and six after 168 hours at room temperature, two and one, respectively, gave negative results. Negative reactions were also given by extracts from smears prepared from field-collected adults of *Z. exsanguis* that appeared not to have fed recently and were subsequently starved for 57 hours at 25°C. or five days at room temperature, or from adults that had fed on larvae of *E. tiliaria* or a Lamellicorn larva. Of 118 smears prepared from examples of *Z. exsanguis* collected in an area in which *M. disstria* was very abundant, *E. tiliaria* less so and *M. americanum* rare, and *Z. exsanguis* had been observed feeding on *M. disstria*, 60, including one from a nymph, gave precipitin rings when tested against the antiserum; there was no difference in the proportion of positive reactions given by the two sexes. It is concluded that the Reduviid commonly feeds on *M. disstria*, at least where the latter is very abundant. Individual predators were later observed to feed on a larva of *M. disstria* at least every fourth day and rarely at intervals exceeding five days at room temperature, and since the presence of antigens can be detected by the antiserum for at least 6–7 days under these conditions, it is concluded that the technique provides an accurate assessment of the proportion of predators feeding on *M. disstria* in the field.

The test was also used in studies of the predators of *Cydia* (*Carpocapsa*) *pomonella* (L.) on apple in Nova Scotia, but the results were complicated by the presence in the orchards of closely related moths, among which *Tortrix* (*Archips*) *cerasivorana* (Fitch) was abundant. Antigens from *T. cerasivorana* and *C. pomonella* each gave positive reactions with antisera prepared from the other. Antisera prepared from both species gave positive reactions with smears from four species of Coccinellids, a Pentatomid, a Nabid and two Arachnids that had fed on larvae of *T. cerasivorana*, and an antiserum from *C. pomonella* also reacted positively with a Trogositid, a Pentatomid, a Reduviid, a Chrysopid and a Nabid that had fed on larvae of *C. pomonella*. An antiserum prepared from pupae of *C. pomonella* gave positive reactions when tested against three Mirids, an Anthocorid and two Phloeothripids suspected of feeding on the eggs of *C. pomonella* or related species. On the basis of these results, the precipitin test is considered to show considerable promise for use in studies of the relations between predators and prey, but difficulty was experienced in producing regularly satisfactory antisera of high titre and avidity, and the occurrence of cross-reactions between species also imposes limitations, though it may be possible to eliminate these by processes of absorption and dilution.

In the second paper, the authors draw attention to various ways in which the precipitin test may be of use in entomological work, outline the technique employed in studies of predator-prey relations, briefly review some of the results recorded in the first paper and discuss the advantages and limitations of the test. Field observations in 1953, when *M. disstria* was less abundant, suggested that *Z. exsanguis* fed less commonly on the larvae under these conditions, and this was confirmed by precipitin tests in which only 26 per

cent. of 70 smears from the adults gave positive reactions. It is concluded that *Z. exsanguis* feeds on *M. disstria* only as a result of chance encounter and is not therefore an important agent of control.

MacGillivray (M. E.). **Note on *Myzus certus* (Walker), an Aphid new to North America (Homoptera: Aphidae).**—*Canad. Ent.* **86** no. 4 p. 190, 2 refs. Ottawa, 1954.

Aphids observed on common pansy (*Viola tricolor*) in New Brunswick in August 1952 were identified as *Myzus persicae* (Sulz.). The plant was transferred to the greenhouse, and sexuales appeared and eggs were laid in November. Since *M. persicae* was not known to lay winter eggs on this plant, specimens were sent to Hille Ris Lambers, who found that they comprised winged viviparae of *M. persicae* and winged viviparae and apterous oviparae of *M. certus* (Wlk.), which was thought to be specific to *V. tricolor* and is here recorded from North America for the first time. In 1953, *M. certus* collected from *V. tricolor* in the same locality was maintained for several generations on potato leaves and young potato plants. Characters differentiating the two species are given.

Lilly (J. H.). **Recent Developments in the Use of Soil Insecticides.**—*FAO Plant Prot. Bull.* **3** no. 6 pp. 81–85, 1 fig., 1 ref. Rome, 1955.

The author reviews the results of experiments on soil treatment with insecticides against maize rootworms (*Diabrotica* spp.) in Iowa [*cf. R.A.E.*, A **43** 244], discusses the value of similar treatments against other soil pests, chiefly those attacking maize, and shows that this method of control is being increasingly used in the United States. A table is included indicating the treatments recommended against specific pests in Iowa in 1955.

Joyce (R. J. V.). **Cotton Spraying in the Sudan Gezira. I. Yield Increase from Spraying and Spraying Methods.**—*FAO Plant Prot. Bull.* **3** no. 6 pp. 86–92, 1 graph, 4 refs. Rome, 1955. **II. Entomological Problems arising from Spraying.**—*T.c.* no. 7 pp. 97–103, 4 refs.

In the first part of this paper, the author discusses the increased yield of cotton obtained since 1945 in the Gezira area of the Sudan (estimated at a total of about 225,000 bales each containing 400 lb. ginned cotton) as a result of spraying with DDT against *Empoasca lybica* (de Berg.) [*cf. R.A.E.*, A **40** 367, etc.]. Since it is desirable to reduce the cost of treatment and essential to treat the whole crop as near the optimum date as possible to give maximum increase in yield [*cf.* **40** 368], studies were made on the most economical types of sprays and on means of accelerating their application. The treatment normally applied is a drenching emulsion spray affording about 1 lb. DDT per acre [*cf.* **40** 368]. Reduction in the volume of spray applied, either by ground machinery or from aircraft, reduces the time required for treatment, and when 1 lb. DDT was applied in 10, 5 and 2·5 gals. spray per acre in 1953–54, the numbers of nymphs of *E. lybica* per 100 leaves during the four weeks following treatment averaged 1, 0·6 and 0·3, respectively. It is thought, however, that there would be little economic advantage in reducing the volume to less than 5 gals. per acre with conventional ground equipment.

The technique adopted in spraying from aircraft in the Gezira is discussed. The DDT product in general use is an emulsion concentrate containing 25 per cent. DDT, and if this is applied undiluted, a rate of application of about

0·4 gal. per acre is required. Investigations by R. Amsden showed that though droplets of a diameter of 200 μ or more of this concentrate caused scorching of the leaves, smaller droplets of the same concentrate or even of one containing 40 per cent. DDT were not injurious. Good results were obtained in 1953 with applications of undiluted 5, 10 and 25 per cent. DDT concentrates at 1 lb. DDT per acre from an aeroplane, the mean Jassid numbers per 100 leaves during the five weeks after spraying being 1·2, 7·4 and 7·3, respectively, as compared with 67·3 on unsprayed plants. An increase in the swathe width from the 65 ft. normally adopted to about 130, 225 or 550 ft. would greatly reduce the time required for treatment, and in an experiment in which the undiluted 25 per cent. concentrate was applied over these four swathe widths, the mean numbers of *E. lybica* per 100 leaves during the six weeks after treatment were 2·3, 4·8, 3·7 and 22·1, respectively, as compared with 213·8 for no treatment; the differences in yield between swathe widths were not significant. The work was being continued in 1954, and it is now believed that a 40 per cent. concentrate applied in droplets of not more than 200 μ at about 0·25 gal. per acre would give a high degree of control and that the leaf coverage given by a swathe width of 130 or 225 ft. would possibly be better than that for 65 ft.

In the second part, the difference in yield increase between the X1730A and Domains Sakel varieties of cotton grown in the wetter southern and drier northern areas of the Gezira, respectively, is discussed. Spraying with DDT has given inferior results in the south, where the climate favours infestation by *Bemisia tabaci* (Gennadius), *Hercothrips* spp. and *Heliothis armigera* (Hb.), as compared with the north, where *E. lybica* alone limits the yield and is more numerous than in the south. Studies have suggested that X1730A is more tolerant of infestation by the Jassid than is Domains Sakel, and the control of this pest on X1730A would therefore result in a less marked increase in yield. As there appears to have been a general decline throughout the Gezira in the quality of the cotton picked since spraying was adopted and hardly any top-grade cotton was produced in the last three years, the possible adverse effects of spraying with DDT on yield and quality were investigated.

Populations of *B. tabaci* frequently increase after spraying with DDT, and in an experiment in 1952, a spray of about 0·25 lb. parathion per acre, applied one, two and three times against *B. tabaci*, in addition to the DDT spray against *Empoasca*, resulted in yield increases of 26, 34 and 24 per cent., respectively, as compared with plants treated with DDT only, and in increased lint length, lint index, weight of seed cotton per boll and seed weight. Severe attack by the Aleurodid causes a deficiency of stored nutrients, and this results in early signs of senescence, shedding of immature bolls and fruiting branches, and reduced yield and quality. An over-all favourable climate is necessary for infestation by *B. tabaci* to become severe. The climate of the Gezira is determined by the passage of the Inter-tropical Front, to which the northerly and southerly winds (north-east and south-east trade winds) converge. *B. tabaci* breeds rapidly during the rainy period, when the air is derived from the damp southerly winds and most of the vegetative growth of the cotton takes place, and slowly in the dry season, when the air is derived from the dry northerly winds. The Inter-tropical Front passes to the south through the Gezira during the second half of October or the first half of November. A season will therefore be favourable for *B. tabaci* if, through early sowing, strong vegetative growth or late arrival of the northerly winds, the crop has completed a dense canopy before the Inter-tropical Front passes to the south, thus prolonging the period of rapid breeding by impeding the movement of the dry north wind over the damp irrigated soil. Spraying with DDT results in the

production of a dense canopy, and though it gives good mortality of the adult Aleurodids, it does not affect the larvae on the lower surfaces of the leaves owing to the limited spray coverage obtained, kills the parasites *Eretmocerus* sp. and *Prospaltella* sp., the first of which has been found to give up to 100 per cent. parasitism of later-instar individuals, and removes competition by *Empoasca*. As a result of these factors, infestation is considerably increased, and special measures of control are needed, such as delayed sowing, the addition to the DDT spray of parathion, which is translocated from the upper to the lower surface of the leaf, or improved coverage with DDT, such as that given by high-volume sprays.

Though the incidence of *H. armigera* is low on sprayed and unsprayed cotton, there appears to be a temporary increase in the number of squares shed in association with damage by it after spraying with DDT. There is no evidence at present of increased loss of crop due to this pest; however, it was found in the experiment in which parathion was tested against *B. tabaci* that though many of the young *Heliothis* larvae were destroyed by this spray, the survival rate was increased and fruit losses were almost 10 per cent. higher than in untreated fields. In the following year they were still greater. *Earias insulana* (Boisd.) and *Platyedra gossypiella* (Saund.), which also attack cotton in the Gezira, are little affected by DDT sprays.

It is hoped that further investigations will establish the minimum dosage of DDT required to bring damage by *E. lybica* within economic limits without effecting complete control, so that predators and parasites are left on the crop. The addition of an insecticide with systemic or translaminar properties may prove necessary against *B. tabaci*.

Outbreaks and new Records.—*FAO Plant Prot. Bull.* **3** no. 7 pp. 108–109, 1 ref. Rome, 1955.

C. G. MacNay (pp. 108–109) gives notes on insects recorded in Canada for the first time in 1953; all are also believed to be new to North America. In addition to two already noticed [*R.A.E.*, A **42** 402; **43** 441], they include *Myzus ascalonicus* Doncaster, which was taken in large numbers on stored chrysanthemum cuttings in New Brunswick and found to have been common on carrot in British Columbia in 1947, *Rhizoecus* (*Coccidella*) sp., which was observed in a greenhouse in Ontario in soil in which African violets had been grown in the winter of 1948–49, *Paranthrene tabaniformis* (Rott.), larvae of which were found boring in twigs of *Populus* sp. in Newfoundland, *Xyleborus obliquecauda* (Motsch.), adults of which were intercepted in wooden orange crates in British Columbia, and the leaf-miner, *Argyresthia aureoargentella* Brower, which was observed on arborvitae (*Thuja* sp.) in New Brunswick in 1951.

Bigi (F.). **Gli ambienti, i parassiti e le malattie del cotone in Africa orientale (Eritrea, Etiopia, Somalia Italiana).** [The Environments, Parasites and Diseases of Cotton in East Africa (Eritrea, Ethiopia and Somalia).]—*Riv. Agric. subtrop.* **47** no. 4–6 pp. 162–176; **48** nos. 1–6 pp. 25–42, 113–129. Florence, 1953–54. (With a Summary in English.)

The author describes the climate of the cotton-growing areas of Ethiopia, Eritrea and Somalia, with special reference to hydrography, reviews the insects and fungi observed attacking the crop in these countries in 1930–40 and their control, and discusses the effects of weather and soil conditions

on plant growth. The insects that caused damage of economic importance in at least one of the years included the Gryllids, *Gryllus* (*Liogryllus*) *bimaculatus* Deg. and *Scapsipedus marginatus* (Afzel.), and the Acridids, *Cyrtacanthacris tatarica* (L.) and *Schistocerca gregaria* (Forsk.), which attacked the seedlings in all three territories, and the Arctiid, *Diacrisia* (*Spilosoma*) *investigatorum* (Karsch), which did so in Ethiopia; termites (including *Coptotermes* spp.) and larvae of the Eumolpid, *Syagrus rugiceps* Lefèvre, which injured the roots in Somalia and the former also in Eritrea; the Gelechiid, *Mometa zemiodes* Durrant, the larvae of which ringed the base of the stems of plants up to 3–4 months old in Somalia; and *Empoasca* sp., probably *E. facialis* (Jacobi), in Ethiopia, *E. facialis* in Somalia and Eritrea, and *Selenothrips indicus* (Bagn.) and *Podagrica uniformis* (Jacoby) in Eritrea and Ethiopia, respectively, all of which injured the leaves. The bolls were attacked by *Dysdercus* spp. in all three territories, *Oxycarenus* spp., *Platyedra gossypiella* (Saund.), *Argyroploce leucotreta* Meyr., *M. zemiodes*, and *Heliothis* (*Chloridea*) *armigera* (Hb.) in Somalia [*cf. R.A.E.*, A **35** 266], *Diparopsis watersi* (Roths.) (*castanea*, auct.) [**40** 67; **43** 6] and *H. armigera* in Ethiopia, and *Earias biplaga* Wlk. in Eritrea.

Szumkowski (W.). **Recomendaciones para el combate de plagas del algodonero, según los resultados de los estudios biológicos.** [Recommendations for the Control of Cotton Pests based on the Results of Studies on their Bionomics.]—*Agron. trop.* **3** no. 4 pp. 273–290, 10 refs. Maracay, 1954. (With a Summary in English.)

Cotton is being increasingly grown in Venezuela, the area under cultivation having doubled between 1950 and 1952. The main pests of the crop are *Alabama argillacea* (Hb.), *Sacadodes pyralis* Dyar, *Heliothis armigera* (Hb.), *H. virescens* (F.) [*cf. R.A.E.*, A **42** 370] and *Anthonomus grandis* Boh. [*cf.* **43** 5], and the damage caused by several of these is increasing. Information recently obtained on their bionomics is reviewed, and control measures based on it are suggested.

Observations on *Alabama argillacea*, which also develops on *Cienfuegosia affinis* and *C. heterophylla* [*cf.* **42** 371–372], showed that the egg, larval and pupal stages lasted about 3, 13–14 and 9–10 days, respectively. The females survived for about 18 days and laid an average of 600 eggs each, with a maximum of 1,500. Insecticides should be applied only to parts of a field that are severely attacked, since indiscriminate treatments directed against the larvae destroy the parasites and predators of this and other pests, without eliminating the risk of reinfestation from migrating adults. Late defoliation by *A. argillacea* may even prove beneficial, since it limits the development of *S. pyralis* and *Heliothis* spp. by hastening maturation. If treatment is necessary, it should be applied not more than 2–3 days after hatching, as the larvae are most susceptible in the early instars.

Information on the bionomics and control of *S. pyralis* has already been noticed [**42** 173]. It is stated that the maximum duration of the pupal diapause was 240 days, as observed in pupae from larvae collected in January 1953 [*cf.* **42** 173]. In order to limit infestation, the sowing of the crop should be completed within 1–2 weeks and should in no case extend over more than 30 days.

H. armigera was of little importance on cotton until 1951, but in October of that year, *H. armigera* and *H. virescens* together destroyed up to 25 per cent. of the green bolls and 10 per cent. of the squares in some fields. In 1952, damage became severe in the State of Aragua in the second half of October. In laboratory observations in January 1953, the egg, larval,

prepupal and pupal stages of *H. armigera* lasted 3, 23, 3–4 and 15–16 days, respectively, but some pupae entered a diapause that lasted 40–204 days. Adult females survived for an average of 18 days and oviposited 2–5 days after emergence, laying an average of 1,700 eggs each with a maximum of 3,100. The eggs were laid preferably on the bracts of the squares, flowers and green bolls. The life-cycle of *H. virescens* was similar to that of *H. armigera*, a pupal diapause being common and lasting 40–175 days. The control measures recommended against *S. pyralis* are also effective against *Heliothis* spp.

Anthonomus grandis develops continuously throughout the year in Venezuela [*cf.* **42** 371], and early sowings of cotton are particularly attractive to adults that survive the dry season. In May 1951, the egg, larval and pupal stages lasted 3, 7 and 4 days, respectively, and the adults became active 1–2 days after emergence. The females oviposited after a further 6–7 days, laying an average of 119 eggs each, with a maximum of 175.

The effect of insecticides on *S. pyralis* is not yet known. A dust of 20 per cent. toxaphene is effective against all the other species, as also is DDT against *Heliothis*. Endrin has given promising results against *Alabama* and *Anthonomus*, and parathion is effective against larvae of *Alabama*, though it is injurious to parasites and predators. Toxaphene is recommended when *Alabama* and *Anthonomus* are present together or conditions are dry, and aldrin when the latter occurs alone or conditions are wet. In cases of severe infestation, treatments should be repeated at intervals of five days.

The importance of natural enemies in the control of cotton pests is emphasised. The Coccinellids, *Ceratomegilla* (*Coleomegilla*) *maculata* (Deg.) and *Cycloneda sanguinea* (L.), are important predators of the eggs and larvae of injurious Lepidoptera. They are voracious, and one adult of *Ceratomegilla* in the laboratory was observed to destroy daily 125 eggs or 80 larvae of *Alabama argillacea*, 120 eggs or 85 larvae of *Laphygma frugiperda* (S. & A.), 425 eggs or 95 larvae of *Prodenia latifascia* Wlk., 95 eggs or 150 larvae of *Agrotis repleta* Wlk. or 125 Aphids. A method of rearing this species on fresh liver in the laboratory has been developed.

Kern (F.). **Nota sobre una nueva forma biológica de** *Laphygma frugiperda* **(S. et A.).** [A Note on a new biological Form of *L. frugiperda*.]—*Agron. trop.* **3** no. 4 pp. 295–300, 4 figs. Maracay, 1954. (With a Summary in English.)

It was observed in 1952–53 that rice seedlings in a field in the State of Portuguesa, Venezuela, had been cut and removed to underground tunnels. In 1953, four of the larvae that were responsible for the damage were removed from the tunnels and taken to the laboratory, where they gave rise to a male and a female of *Laphygma frugiperda* (S. & A.). As such behaviour is unknown in this species, further generations were reared. The coloration of the adults and third-instar larvae varied somewhat from that usually observed, though no differences were noticed in the eggs and young larvae, and microscopic examination of the male genitalia showed no variations from those of normal laboratory-reared individuals of *L. frugiperda*. The third-instar larvae constructed tunnels just below the surface of the soil, in which they remained during the day, emerging at night to cut young plants or leaves, on which they fed in the tunnels. In tests with the third laboratory generation, larvae were reared without soil until the third instar and then transferred to jars containing soil; 80 per cent. of them entered the soil immediately, as compared with none of the normal laboratory strain. Fourth-generation adults paired with those of the normal strain in both directions, and oviposition and hatching occurred without hindrance.

Rosborough (T.). **Control of Turnip Gall Weevil on Cabbage.**—*Plant Path.* **2** no. 4 pp. 123–125, 2 refs. London, 1953.

Damage to cruciferous crops in Britain by *Ceuthorrhynchus pleurostigma* (Marsh.) is sometimes considerable under adverse growing conditions. No satisfactory insecticide has hitherto been available for control of the weevil [*cf. R.A.E.*, A **11** 462], but since BHC proved of value in Switzerland [*cf.* **35** 384], dusts of this and other materials were tested in Gloucestershire in 1951–52. In a preliminary test of treatments applied in the seed-bed in 1952, cabbage seedlings dusted with 2 per cent. technical BHC powder (0·26 per cent. γ BHC) in June, when they had one pair of foliage leaves, remained free from attack for a month, whereas those dusted with 5 per cent. DDT or left untreated showed 7 and 13 per cent. infestation, respectively. In another test in which the same dusts and one of 10 per cent. toxaphene were applied to the seedlings in a 2-in. band along the rows in August, the percentage infested at transplanting in September was reduced from 23·5 to 1·5, 16·5 and 10·5, respectively, all differences being significant. When the BHC and DDT dusts were applied at five other places several miles apart, BHC gave complete protection at all except one place, whereas the percentage infestation varied from 7 to 16 for DDT and from 13 to 24 for no treatment. None of the insecticides caused any plant injury.

The value of treating older plants was tested on spring and winter cabbage by applying the dusts round the base at the rate of 1 lb. per 160 plants three days after transplanting. The spring cabbages were treated on 17th September with 5 per cent. DDT, 2 per cent. BHC and 4 per cent. calomel [mercurous chloride], and 14·2, 3·3 and 23·3 per cent. of the plants, respectively, were infested at harvest, in the following spring, as compared with 31·7 per cent. for no treatment. The corresponding percentages for winter cabbages treated on 12th July were 80, 4·4 and 92·2, respectively, as compared with 88·9. BHC gave significant reduction in both tests, and DDT did so in the first.

Legowski (T. J.) & Gough (H. C.). **Observations on the Bulb and Potato Aphid *Rhopalosiphoninus latysiphon* (Davidson) in East Anglia.**—*Plant Path.* **2** no. 4 pp. 126–130, 11 refs. London, 1953.

Rhopalosiphoninus latysiphon (Davidson) was first recorded in Britain in 1944, when it occurred on the sprouts of clamped potatoes in Lincolnshire, and it was reported in the same paper [*R.A.E.*, A **37** 90] to have been found in 1945 on the shoots of potato tubers set to sprout prior to planting, on potato roots in two fields, and on tulips and tulip bulbs in the same area, into which it may have been introduced from Holland. It failed to transmit potato virus Y. In late August 1951, it was found on the roots of potato in three fields in the Isle of Ely (Cambridgeshire), and in the following year, ten of 18 fields in the same district were infested. Other European countries in which the Aphid occurs are Switzerland [*cf. R.A.E.*, A **43** 199, etc.], Germany [**41** 185] and Austria [**40** 215], and it is also known from California [cf. **39** 419], but it has rarely been recorded on the roots of potato plants in the field, and observations were therefore made on its bionomics in the laboratory and on the field infestations.

Colonies of *R. latysiphon* were maintained throughout the winter of 1951–52 on sprouting potatoes and young potato plants in the greenhouse and laboratory. The Aphids became established on almost any part of the plant that was young and tender or deficient in chlorophyll and were distributed over the stem on plants kept in darkness; they showed no

tendency to move towards the roots or to penetrate from superficial to lower roots [*cf.* **39** 419]. Small colonies became established on the tender aerial parts of young pea and wheat plants, sainfoin [*Onobrychis sativa*], various grasses, and weeds (*Veronica hederaefolia*, *Papaver rhoeas*, *Sonchus arvensis* and *Urtica urens*), but these plants were less favourable than potato sprouts. No sexual forms were seen. At room temperatures during March–April, development of the apterae up to the beginning of reproduction required ten days. Moist conditions were preferred. One adult survived for as long as 44 days, during the first 23 of which it deposited 71 nymphs; reproduction was in general highest during the first fortnight of adult life, and the maximum number of nymphs produced in 24 hours was six. There was considerable individual variation in survival period and fertility.

The fields infested in 1951 were all on rather heavy loam soil; they had previously been under cereals, and the seed potatoes had been imported from Scotland and sprouted prior to planting in two houses, both of which had been fumigated as a routine measure in October. No bulbs were grown in the district. In one of the fields, plant infestation reached 40 per cent. and was fairly evenly distributed, but in the other two it was patchy. Up to 3,000 Aphids in all stages, including some alates, were observed per plant, mostly under the bases of the stems near the old tubers and all on underground parts.

In 1952, infestation was found in August–September in several fields near Whittlesey. It ranged in general from 10 to 25 per cent., but exceeded 90 per cent. in one field. All the crops had been grown from tubers allowed to sprout prior to planting, except two, in which tubers that had and had not sprouted prior to planting were mixed and in which infestation was patchy; two other fields planted with tubers that had not previously sprouted were not infested. It therefore appeared that attack began in the houses during sprouting, though it also developed in fields planted with sprouting tubers on which Aphids had not been present shortly before planting. In a laboratory test, nine uninfested sprouting tubers placed with two moderately infested ones on a tray kept in semi-darkness all became infested in five days. No Aphids were found on the plants in the heavily infested field on 30th October, when the haulms and roots were dead but the tubers not yet harvested, and they did not occur in August on self-set potato plants in the fields that had been infested in 1951, which were mostly under wheat, but were found in clamps of tubers from infested fields in January and subsequently and on the roots of potatoes growing in the remains of a clamp in August.

In a test in which 25 sprouting tubers were planted on 5th April in three rows in a plot on gravelly loam soil and alternate tubers in the middle row were infested with 20–30 apterae, the roots of five of nine tubers, including one of those originally infested, bore up to 20 Aphids each when examined on 27th June. The rest were lifted in mid-August, but the roots were not infested, though three immature apterae were present on the roots of *Solanum nigrum* growing among them. The light soil and prevalent dry conditions may have reduced the infestation. Other weeds on which root infestation was found in the fields comprised *U. urens*, charlock (*Sinapis arvensis* (*Brassica sinapis*)), *Tussilago farfara*, and *Agropyrum repens*.

The effect of the Aphid on yield was investigated on samples of 60 plants taken from the heavily infested field on 4th September and again 15 days later; the yield from heavily infested plants on the earlier date and from both heavily and moderately infested plants on the later one was significantly below that from the slightly infested plants; moderate and heavy infestations were also associated with poor general appearance and a high proportion of yellowed leaves.

Henderson (D. M.). **Virus Yellows of Shallots.**—*Plant Path.* **2** no. 4 pp. 130–133, 4 refs. London, 1953.

Virus yellows of shallots, which causes stunted growth, premature yellowing of the leaves and often a reduction in the size of the bulbs, has been known in England and Wales since 1936 and in Scotland since 1940 and is now widespread in Britain. A certification scheme for planting material was introduced in Scotland in 1947, and it includes a provision that stocks shall be grown at least 50 yards from any beds of onion, leek, chives, garlic or vegetable marrows or from any shallots not entered for inspection or showing more than 0·5 per cent. visible infection. As this distance was chosen arbitrarily, experiments were begun near Edinburgh in 1949 on the transmission of the disease.

Preliminary tests showed that the virus was transmitted by sap with difficulty to young shallots and onions and not at all to tobacco, *Datura stramonium*, *Nicotiana glutinosa* and cucumber, thus resembling onion yellow dwarf more than cucumber mosaic. In tests with Aphids, apterae of *Aphis fabae* Scop., *Myzus persicae* (Sulz.) and *M. ascalonicus* Doncaster all transmitted it from shallot to shallot, though the first two fed with reluctance on this plant and usually died within a few days on it. A period of fasting before the virus was acquired increased the proportion of plants infected. In tests with *M. persicae*, feeding periods of ten minutes on the infected and healthy plants were sufficient for transmission, and the virus appeared to be of the non-persistent type. *M. persicae* was a slightly more effective vector than *M. ascalonicus*, but the latter is probably the more important, since it frequently infests stored shallots [*cf. R.A.E.*, A **35** 205] and other Aphids do not feed readily on the plant. Transfers of *M. ascalonicus* from infected plants to dormant shallots gave negative results.

Field experiments on the spread of the disease in 1949–51 indicated that plants immediately adjacent to infected ones are the most likely to become infected and that spread over even as short a distance as 34 ft. was slight. The required isolation distance of 50 yards is thus more than ample. The yield of bulbs from infected plants was significantly lower than that from healthy ones.

Priestley (G.). **Use of Honey Bees as Pollinators in unheated Glasshouses.** —*N.Z. J. Sci. Tech.* **36** (A) no. 3 pp. 232–236, 3 refs. Wellington, N.Z., 1954.

Insect-pollinated plants cultivated for stock seed at plant breeding stations are difficult to isolate by distance owing to the small numbers involved, but good results were obtained at a research station in New Zealand by growing them in a range of lean-to, unheated, insect-proof glasshouses divided into separate units each capable of holding 40 cabbage plants. The presence of insects was necessary for cross-pollination however, and in 1953 honey bees introduced for this purpose successfully pollinated a crop of savoy cabbages and a satisfactory yield of seed was obtained. The technique adopted is described. Two nucleus hives, each consisting of six frames, were used in each unit, but one would probably have been sufficient. It was necessary to shade the glass to prevent the bees from flying up to it and to keep the units as cool as possible. Mortality among the bees was high, in part owing to unavoidably high temperatures, but the total population of the hive appeared to be maintained, and the hives were in a satisfactory condition at the end of the pollination period.

del Cañizo Gómez (J.) & González de Andrés (C.). **Manual práctico de fitopatología y terapéutica agrícola.** [A practical Handbook of agricultural Phytopathology and Therapeutics.]—9 × 6 ins., xxiv + 557 pp., 2 col. pls., 324 figs. Madrid, Minist. Agric., Direcc. gen. Coord., Crédito y Capacit. agr., 1955. Price 150 *pesetas*.

This handbook, which has special reference to conditions in Spain, is divided into four parts. The first contains an introductory chapter on the agents that injure cultivated plants, others on the morphology and habits of insects and on fungi, viruses, weeds, parasitic plants and rodents, and an account of the organisation of phytopathological services in Spain. The second part deals with measures of control and includes chapters on insecticides, fungicides, herbicides and rodenticides in common use, with notes on the forms in which they are applied, the preparation of sprays, dusts and baits, and the types of apparatus used for their application, these last being treated and illustrated in some detail. The third part is concerned with the application of control measures and includes chapters on the technique of applying sprays and dusts, fumigating trees (largely *Citrus*) with hydrogen cyanide and fumigating granaries, stored products and nursery stock. The fourth part deals with particular cultivated plants and has chapters on the principal insect pests and diseases of vines, olives, fruit trees, cereals and leguminous crops, potato, beet and cotton, and vegetable crops, with, in most cases, notes on their recognition and control. There is also a chapter on the habits of locusts and the measures adopted against them.

Sugonyaev (E. S.). **The Combination of chemical and biological Methods as shown by an Example of the Control of Soft Scales (Homoptera, Coccoidea) on** *Citrus*. [*In Russian.*]—*Dokl. Akad. Nauk SSSR* **101** no. 2 pp. 375–377, 10 refs. Moscow, 1955.

The possibility of using insecticides for the control of soft scales on *Citrus* in the Soviet Union without injuring their parasites was studied in 1954 near Sochi, on the Black Sea coast, where *Coccus pseudomagnoliarum* (Kuw.) and *C. hesperidum* L. are common on *Citrus*, and *Coccophagus lycimnia* (Wlk.) is the most important parasite of both. This Aphelinid infests its hosts towards autumn [*cf. R.A.E.*, A **43** 96], and the sprays of 1 per cent. mineral-oil emulsion that are commonly applied against the Coccids frequently kill the developing parasites and thus increase the infestation. To study the effect of the oil spray on the pupae of *C. lycimnia*, which occur in the mummified hosts in the second half of April or, if the spring is cold, at the beginning of May, it was applied to orange trees infested with second-stage nymphs of *Coccus pseudomagnoliarum*, up to 84 per cent. of which were parasitised by *Coccophagus lycimnia*, over 72 per cent. of which were in the pupal stage. There was little difference in the numbers of adult parasites that emerged on the treated and untreated control trees, indicating that the spray was harmless to the parasite pupae. Subsequent parasitism was heavy, and the treated trees became free from infestation by the middle of the summer, whereas the untreated control trees were heavily infested and their vigour reduced.

To determine the best time for spraying so as not to harm the adult parasites, mandarin-orange trees were sprayed and covered with muslin cages in which parasites were released. The results showed that 70–100 per cent. of the parasites were killed on the day of spraying by contact with the droplets, but that mortality was thenceforward not high.

When the spray was applied in summer to trees infested by *Coccus pseudomagnoliarum* containing larvae of the parasite, it reduced the density of the Coccid by 65·5 per cent., but the percentage parasitism dropped from 26·6 to 5, whereas it remained more or less stable in the controls.

In tests to determine the effect of summer spraying on overlapping generations of the parasite, lemon trees infested with *C. hesperidum* were sprayed at the beginning of the flight of the fourth generation of the parasite. The percentage parasitism on the treated plants increased in proportion as mortality of the Coccid rose, but the parasite population decreased because larvae in their hosts and some of the adults were killed. It is concluded that the parasite will be least harmed by summer spraying if it is effected at the beginning of the flight of each successive generation, while pupae are the predominant stage.

The same findings applied almost completely to *Encyrtus* (*Eucomys*) *lecaniorum* (Mayr), which is an effective parasite of *C. hesperidum* in the districts of Sochi and Adler, but not to *Coccophagus scutellaris* (Dalm.). The latter does not mummify its host, but emerges while the scale is still alive, and is thus killed by summer sprays that kill the parasitised host. Summer sprays should therefore not be applied where *C. scutellaris* is particularly active.

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